



Allen-Bradley

Non-Regenerative DC Bus Supply Unit (NRU)

Bulletin 2364E

User Manual

**Rockwell
Automation**

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. “*Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls*” (Publication SGI-1.1 available from your local Allen-Bradley Sales Office or online at <http://www.ab.com/manuals/gi>) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will the Allen-Bradley Company be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, the Allen-Bradley Company cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Allen-Bradley Company with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of the Allen-Bradley Company is prohibited.

Throughout this manual we use notes to make you aware of safety considerations.



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

Attentions help you:

- identify a hazard
- avoid the hazard
- recognize the consequences

Important: Identifies information that is especially important for successful application and understanding of the product.



Shock Hazard labels may be located on or inside the drive to alert people that dangerous voltage may be present.

Updated Information

This manual incorporates the information found in the previous two manuals:

- *Non-Regenerative DC Bus Supply*, Publication 2364E-5.01 August 1997
- *Non-Regenerative DC Bus Supply*, Publication 2364E-5.01 March 1998

It also contains new information.

Updates and Additions

The information below summarizes the changes to this manual since its last release:

Page	Description
C-7	Replaced two figures for one graphic. Figure 10: Phase-Loss Relay Wiring Diagram
C-8	Section: <i>Setting Jumpers for The Phase-Loss Relay</i> removed

End of Summary of Changes

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Read this preface to familiarize yourself with the rest of this manual. This preface covers the following topics:

- who should use this manual
- the purpose of this manual
- safety precautions
- contents of this manual
- related documentation
- conventions used in this manual
- drive system receiving
- Rockwell Automation support

Who Should Use This Manual

Use this manual if you are responsible for installing or operating a Rockwell Automation non-regenerative, common DC bus supply unit (NRU™).

If you do not have a basic understanding of the NRU, contact your local Rockwell Automation Drive Systems representative for information before using this product.

Purpose of This Manual

This manual provides installation and software configuration instructions for Rockwell Automation's NRUs.

Safety Precautions

The following general precautions apply to Bulletin 2364E NRUs and to drive system lineups:



ATTENTION: Only those familiar with the drive system, the products used in the system, and the associated machinery should plan or implement the installation, startup, and future maintenance of the system. Failure to comply can result in personal injury and/or equipment damage.

ATTENTION: Only connect Rockwell Automation common DC bus AC drives to the NRU's common DC bus output.



ATTENTION: Verify that all sources of AC and DC power are deenergized and locked out or tagged out in accordance with the requirements of ANSI/NFPA 70E, Part II.

ATTENTION: The system may contain stored energy devices. To avoid the hazard of electrical shock, verify that all voltage on capacitors has been discharged before attempting to service, repair, or remove a drive system or its components. You should only attempt the procedures in this manual if you are qualified to do so and are familiar with solid-state control equipment and the safety procedures in publication NFPA 70E.

ATTENTION: An incorrectly applied or installed drive system can result in component damage and/or a reduction in product life. Wiring or application errors — such as undersizing the motor, incorrect or inadequate AC supply, and excessive ambient temperatures — can result in the malfunction of the drive equipment.

ATTENTION: This drive system contains ESD (electrostatic discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, or repairing this assembly. Component damage can result if ESD control procedures are not followed. If you are not familiar with static control procedures, refer to Rockwell Automation publication 8000-4.5.2, *Guarding Against Electrostatic Damage*, or any other applicable ESD protection handbook.

Contents of this Manual

Chapter	Title	Contents
	Preface	Purpose, background, and scope of this manual
1	Overview	Theory of operation, features, and standard options
2	Your 180A DC NRU (Current Code A)	Schematics and connection diagrams for the 180A DC NRU
3	Your 350A DC NRU (Current Code B)	Schematics and connection diagrams for the 350A DC NRU
4	Your 900A DC NRU (Current Code C)	Schematics and connection diagrams for the 900A DC NRU
5	Your 1500A DC NRU (Current Code D)	Schematics and connection diagrams for the 1500A DC NRU
6	Your 2000A DC NRU (Current Code E)	Schematics and connection diagrams for the 2000A DC NRU
7	Your 2500A DC NRU (Current Code F)	Schematics and connection diagrams for the 2500A DC NRU
8	Your 3000A DC NRU (Current Code G)	Schematics and connection diagrams for the 3000A DC NRU
9	Installing Your NRU	NRU wiring information and installation procedures
10	Troubleshooting	Checklist for identifying problems with your 2364E system
Appendix A	Specifications	Physical, electrical, environmental, and functional specifications for the 2364E
Appendix B	NRU Catalog Numbers and Spare Parts Kits	Catalog number descriptions of available NRUs
Appendix C	NRU Details	NRU details including AC input connections and wireway meter covers

Related Documentation

The following documents contain additional information concerning related Rockwell Automation products and related standards. To obtain a copy of Rockwell Automation publications, contact your local Rockwell Automation office or distributor.

For	Read This Document	Document Number
Information on the 1336 Force™ drives	1336T User Manual — AC Drive	1336 FORCE-5.12
Information on the 1336 Plus drives	1336S User Manual — .05-600HP	1336 PLUS-5.0
Information on 1336 dynamic braking modules consisting of both chopper and resistors	Installation Data — HD Dynamic Braking	1336-5.64
Information on 1336 braking chopper modules	Chopper Brake Module Installation Instructions	1336-5.65
PLC-5™ information	PLC-5 Controllers Brochure	1785-1.2
Bulletin 1403 Powermonitor II information	Bulletin 1403 Powermonitor II	1403-5.0
Information on the Bulletin 1403 communication module	Smart Communications Card	1403-5.1
Additional Information on joining and splicing together MCCs	Instructions — Joining and Splicing Vertical	2100-5.1
Details on receiving, handling, and storing MCCs	Instructions — Receiving, Handling, and Storing Motor Control Centers	2100-5.5
Provides procedures for those tasks that need to be done at the customer's site before system start up	Bulletin 2300 Installation Manual	2300-5.1
A description of Drive Tools™ software	Drive Tools Software Brochure	9303-1.0
Information on SA3000 drives	SA3000 Binder	S-3001
Information on SA3100 drives	SA3100 Binder	S-3053
Information on FD86N enclosures	FD86N Drive Systems Enclosure Hardware Installation Manual	S-3062
An article on wire sizes and types for grounding electrical equipment	National Electrical Code	ANSI / NFPA 70 Published by the National Fire Protection Association of Boston, MA
An article on safety procedures	Standard for Electrical Safety Requirements for Employee Workplaces	ANSI / NFPA 70E
A complete listing of current documentation, including ordering instructions. Also indicates whether the documents are available on CD-ROM or in multi-languages	Allen-Bradley Publication Index	SD499
A glossary of industrial automation terms and abbreviations	Industrial Automation Glossary	AG-7.1

Common Techniques Used in this Manual

The following conventions are used throughout this manual:

- NRU unit configurations are referred to by their catalog string current code (Refer to Appendix B for code definition.).
- Bulleted lists such as this one provide information, rather than procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- When you are referred to another location, the section name appears in italics.
- The exclamation point inside of a triangle followed by the word "**ATTENTION**" indicate circumstances that can lead to personal injury, death, property damage, or economic loss.

Drive System Receiving

You, the customer, are responsible for thoroughly inspecting the equipment before accepting the shipment from the freight company. Check the item(s) that you receive against your purchase order. If any items are obviously damaged, it is your responsibility to refuse delivery until the freight agent has noted the damage on the freight bill. Should you discover any concealed damage during unpacking, you are responsible for notifying the freight agent. Leave the shipping container intact and request that the freight agent make a visual inspection of the equipment.

Rockwell Automation Support

Rockwell Automation offers support services worldwide, with Sales/Support Offices, authorized distributors, and authorized Systems Integrators located throughout the United States, plus Rockwell Automation representatives in every major country in the world.

Local Product Support

Contact your local Rockwell Automation representative for:

- sales and order support
- product technical training
- warranty support
- support service agreements

Technical Product Assistance

If you need to contact Rockwell Automation for technical assistance, please review the product and troubleshooting information in this manual first. Then, call your local Rockwell Automation representative. For the quickest possible response, we recommend that you have the catalog numbers of your products available when you call.

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Overview

This chapter introduces Rockwell Automation's Bulletin 2364E common DC bus, non-regenerative unit (NRU), describes the theory of NRU operation, and provides comprehensive lists of NRU features and standard options. Appendix A contains specifications on available NRUs. Appendix B contains NRU catalog numbers with descriptions. Appendix C provides some other details concerning AC input connections, bus locations, and wireway meter covers.

What is the 2364E?

We designed the NRU to be our single-direction power converter for the front-end of a common DC bus drive system. Read this section for a general description of NRU functionality and packaging.

What does the NRU do?

The NRU converts an incoming 3-phase, AC line voltage into:

- a common DC bus voltage and current
- a 115V AC NRU control voltage via a basic capacity control transformer (Control power source upgrade options allow you to select an increased transformer capacity to supply control power to a 115V AC control bus)

The NRU applies the common bus DC voltage to the system power bus and the 115V AC control voltage to a system control bus, if desired. The system power bus and the control bus, if present, then supply the voltage(s) to the remainder of the system.

How will the NRU fit into a 2362 drive system?

We packaged the NRU in CENTERLINE™ Bulletin 2100 motor control centers (MCC) to be compatible with our existing 2362 AC drive system lineups. As an added convenience, you can connect other MCCs to both the right and left sides of an NRU.

How will the NRU fit into a drive system packaged in FD86N enclosures?

FD86N enclosure options permit direct connection to Bulletin 2100 CENTERLINE MCCs that:

- are 20" deep
- have 1.5"-high base channels
- have the DC power bus and control bus (if selected) mounted at a depth of 16.94" from the front of the MCC

How Does An NRU Work?

To help you to understand the theory behind how an NRU works, read this section for descriptions of the primary electrical components, a conceptual schematic, and a discussion of rectifier bridge operation.

Primary Electrical Components of the NRU

The primary electrical components of the NRU are:

- a 3-phase circuit breaker or motor circuit protector, depending upon NRU rating
- AC line, current-limiting fuses
- a six-pulse, full-wave, 3-phase-diode-bridge rectifier unit
- a DC bus choke
- a control power transformer
- primary and secondary control transformer fusing

Motor Circuit Protector

The motor circuit protector is the switching device between the NRU and the 3-phase AC source used to turn power to the system on and off; it also provides magnetic overload protection. Motor circuit protectors are standard features in 180A DC and 350A DC NRUs.

3-Phase Circuit Breaker

The 3-phase circuit breaker is the switching device between the NRU and the 3-phase AC source used to turn power to the system on and off; it also provides overcurrent trip and magnetic overload protection. 3-phase circuit breakers are standard features in 900A DC, 1500A DC, 2000A DC, 2500A DC, and 3000A DC NRUs.

AC Line, Current-Limiting Fuses

These fuses are located between the circuit breaker (or motor circuit protector) and the diode-bridge rectifier unit. This fusing protects the diodes from excessive currents and provides a current-limiting action that permits a circuit breaker or motor circuit protector (with a withstand rating less than 65,000A AC fault current available) to effectively provide an AIC rating of 65,000A AC.

Six-Pulse, Full-Wave, 3-Phase-Diode-Bridge Rectifier Unit

The bridge rectifier converts the 3-phase AC power to DC.

DC Bus Choke

The DC bus choke reduces peak currents in the AC line and the bridge circuit. The DC bus choke also reduces line harmonics.

Control Power Transformer

This transformer steps down 2 phases of the 3-phase AC line voltage to a single-phase, 115V AC control signal.

Primary and Secondary Control Transformer Fusing

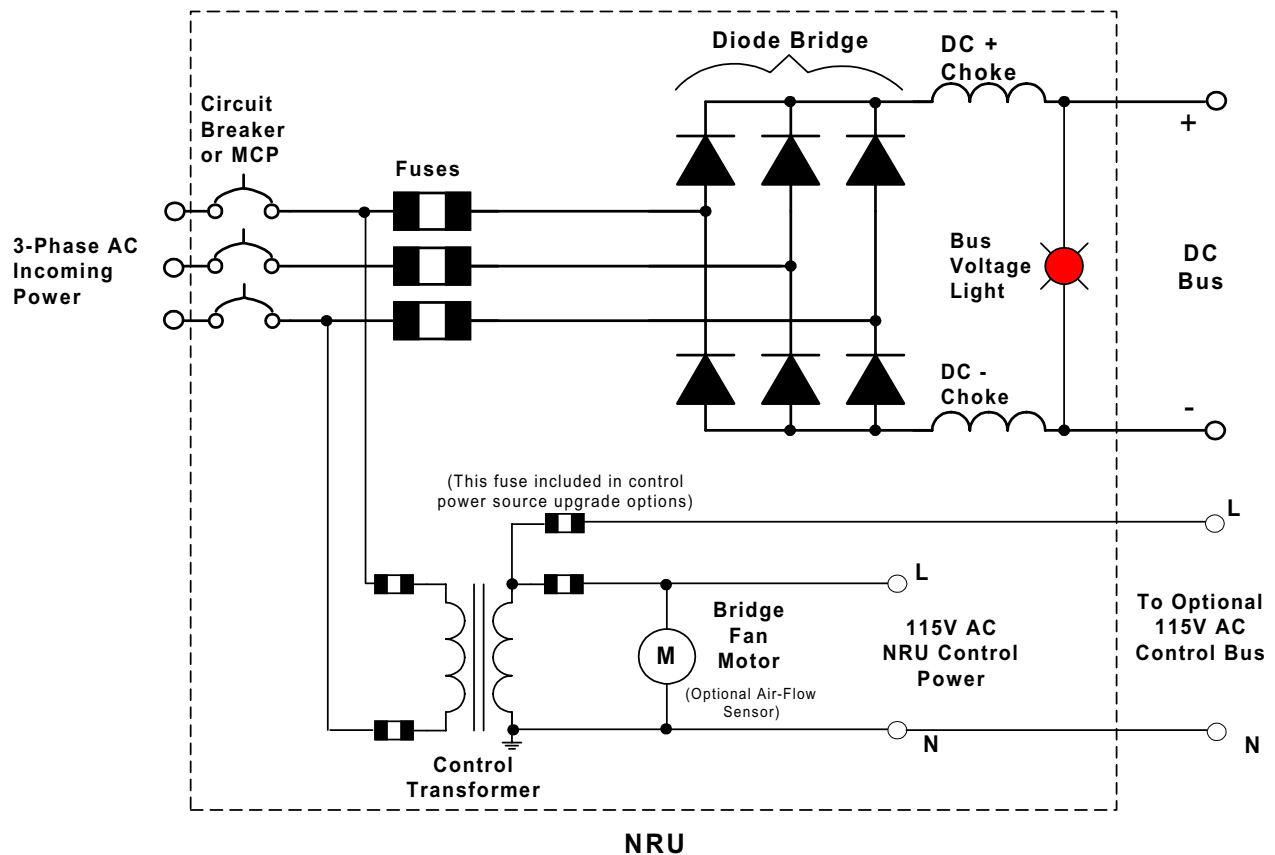
Control transformer fusing protects the transformer and control circuitry from excessive currents.

NRU Conceptual Schematic

Customer-supplied, 3-phase AC power is supplied to the system as shown on the left side of the NRU schematic shown in Figure 1.1. All three phases are fused and then connected to the diode-bridge rectifier, as shown. The diode-bridge rectifier is also connected through DC bus chokes to the DC bus.

Two of the three AC input phases are routed through primary control transformer fusing to the control transformer. The secondary of the control transformer, which supplies the NRU control power, can be connected to the control bus after fusing if the control transformer is sized accordingly. The bridge fan is connected to the NRU control power.

Figure 1.1
Conceptual Schematic of the NRU



Power Conversion Operation

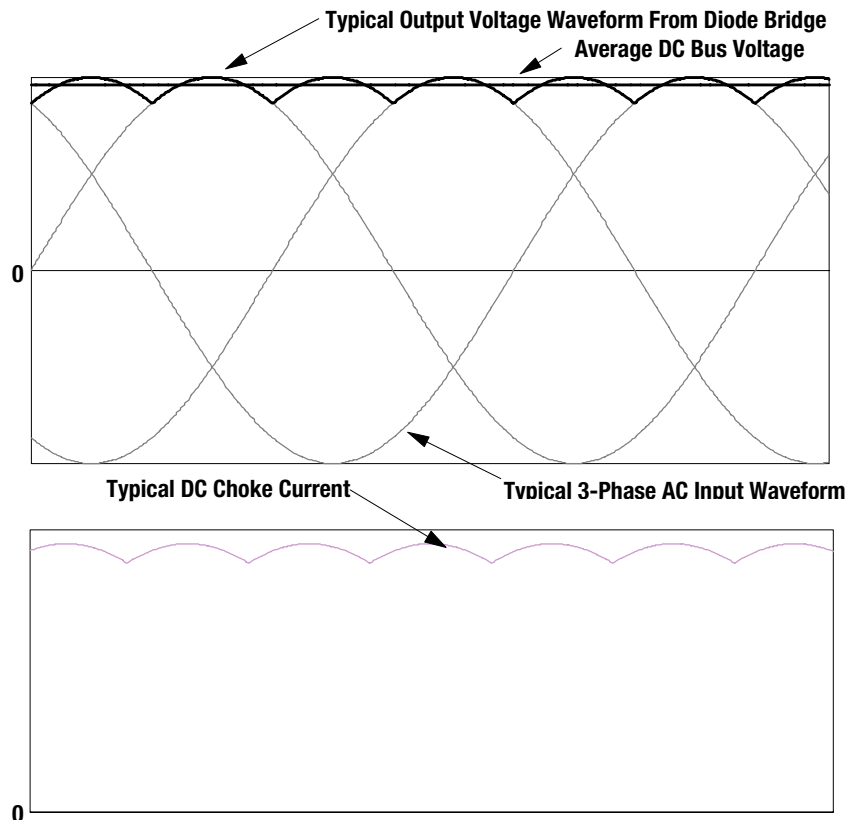
The diodes in the rectifier bridge will only permit current flow in one direction, from anode to cathode. When an AC voltage is applied to a diode, the output of that diode is a pulsating DC signal (positive half-cycles only).

For any particular phase, the anode of the upper diode is positive relative to its cathode during the positive half-cycle of the AC input. This forward (voltage) biases the upper diode and it conducts. Meanwhile, the anode of the lower diode is negative relative to its cathode. This reverse biases the lower diode and it does not conduct. Similarly, during the negative half-cycle of the AC input, the lower diode conducts and the upper diode does not conduct.

During the operation of a 3-phase bridge rectifier, multiple upper and/or lower diodes may simultaneously be biased correctly for conduction.

A 3-phase bridge provides an average DC output voltage that is approximately 1.35 times the rms line-to-line voltage. Refer to Figure 1.2 for an illustration of the 3-phase AC input signal applied to the bridge rectifier and the DC output.

Figure 1.2
3-Phase AC Line Voltage and DC Output Voltage and Current



Bulletin 2364E NRU – Standard Features

Electrical System Features

- A 3-phase circuit breaker / motor circuit protector rated for 65kAIC:
 - 180 and 350A DC units have motor circuit protectors
 - 900, 1500, 2000, 2500, and 3000A DC units have circuit breakers
- AC line, current-limiting fuses rated at 600V AC with short circuit protection rated at 65kAIC
- A six-pulse, full-wave, 3-phase-diode-bridge rectifier unit
- A DC bus choke with inductance in both +/- legs
- A "basic capacity" control power transformer that supplies ONLY the NRU with single-phase, 115V AC control power
- Primary and secondary control transformer fusing (excluding the control bus fuse that is supplied with the "6P" and "6PX" control power source upgrade options)
- A "DC-Bus-Energized" pilot light that turns on when the bus voltage is above 50V DC
- Compatible with Bulletin 1336 dynamic braking (DB) chopper units

***Note:** A dynamic braking chopper unit requires an additional cabinet section.*

- A bridge suppressor module
- Configurations available for 230, 380, 460, and 575V AC inputs with 180, 350, 900, 1500, 2000, 2500, and 3000A DC outputs
- Utilization of #16 AWG MTW (PVC insulated) rated, stranded copper control wiring

Packaging Features

- Utilization of Bulletin 2100 CENTERLINE motor control center (MCC) packaging makes the NRU compatible with other Bulletin 2100 and 2300 products
- Unit depth of 20"
- DC bus and control bus (if selected) depth at
 - 11.9 inches in 180 and 350A DC (current codes A and B) units
 - 16.9 inches in 900, 1500, 2000, 2500, and 3000A DC (current codes C, D, E, F, and G) units

- Ability to connect to other MCC sections on both the right and left sides
- Top-entry AC line input
- Removable top-plate for cutting conduit holes
- 6"-high, full-section-depth, horizontal wireway at top of MCC enclosure

***Note:** The front-half of the top horizontal wireway is typically reserved for the routing of control/communication wires.*

- Easy accessibility for routine maintenance
- Motor circuit protector in 180 and 350A DC (current codes A and B) units and circuit breakers in 900, 1500, 2000, 2500, and 3000A DC (current codes C, D, E, F, and G) units are padlockable
- 180 and 350A DC (current codes A and B) units have removable diode power bridge assembly
- Tin-plated copper horizontal power busbars and PE/TE busbars
- Standard power bus bracing rated at 65kAIC
- Horizontal PE and TE copper bus that is bottom-front mounted
- ASA49 gray, baked-enamel finish
- Vented unit door(s) with door fan(s) where appropriate
- Units come standard with cloth wire labels
- NRUs can connect to FD86N enclosures on either or both sides, provided that the NRU:
 - is 20 inches deep
 - has 1.5" high base channels
 - has its DC bus and control bus (if supplied) mounted at a depth of 16.94 inches

Bulletin 2364E NRU – Standard Options

Electrical System Options

- Analog DC bus voltage metering
- Analog AC input current metering (Phase A only)

***Note:** The bus voltmeter and/or AC input ammeter are mounted in a special wireway meter cover that is angled for easy viewing.*

- AC input and output power metering (kW) using Powermonitor II (Bulletin 1403) for NRUs powered by 3-phase, grounded-wye secondary supplies
- Powermonitor II communication module for connecting the Powermonitor II to Remote I/O, RS-232, or RS-485 devices
- A door-mounted "Unit-Not-Faulted" pilot light that monitors air flow sensor(s), heatsink temperature sensors, phase loss relay, and an optional remote interlock (if supplied by customer)
- A door-mounted, ground-fault detection meter for NRUs powered by 3-phase, grounded-wye secondary supplies
- Standard capacity ("6P") and extra capacity ("6PX") control power source upgrade options are available to provide 115V AC control bus power

***Note:** "6P" and "6PX" options include control bus fuse and control busbar mounted in cabinet above power bus.*

- An air-flow-loss switch in all Diode Power MCC sections and in 2500/3000A DC Input Power MCC sections. This option monitors critical NRU air flows for proper CFM
- A line RC suppressor module to reduce AC line transients

***Note:** The line RC suppressor module is recommended when the primary voltage of the supply transformer is 2300V AC or greater.*

Packaging Options

- Tin-plated control bus mounted in rear of cabinet above the power bus

***Note:** Control bus is included as part of the control power source upgrade options.*

- Depth of DC bus and control bus (if supplied) at 16.9 inches in 180 and 350A DC (current codes A and B) units
- 115V AC, 15A duplex receptacle

***Note:** Customer supplies single-phase, 115V AC power and wiring to the duplex receptacle.*

- A phone jack
- Gasketed unit door areas and door-fan filters
- Brady Datab™ wire labels offering the added protection of a clear plastic cover on top of the labels

***Note:** Units come standard with cloth wire labels.*

Your 180A DC NRU (Current Code A)

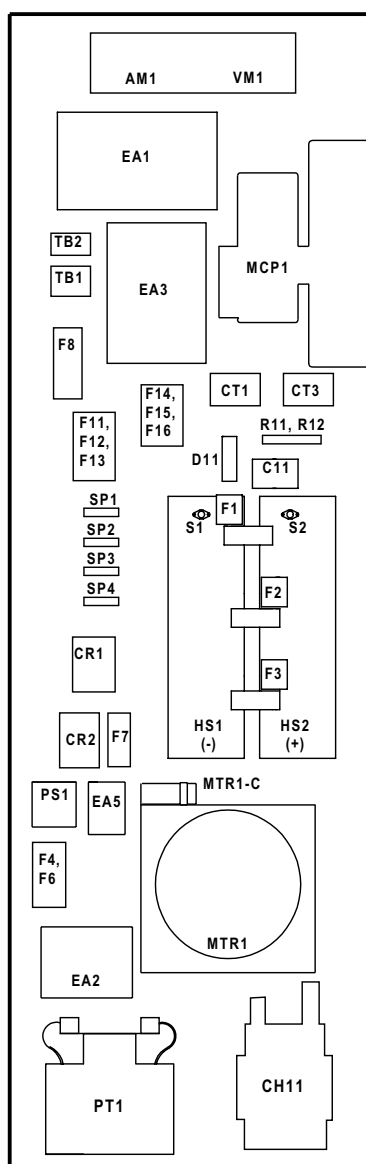
Input Voltage (V AC)	Rated DC Bus kW
230	56
380	92
460	112
575	140

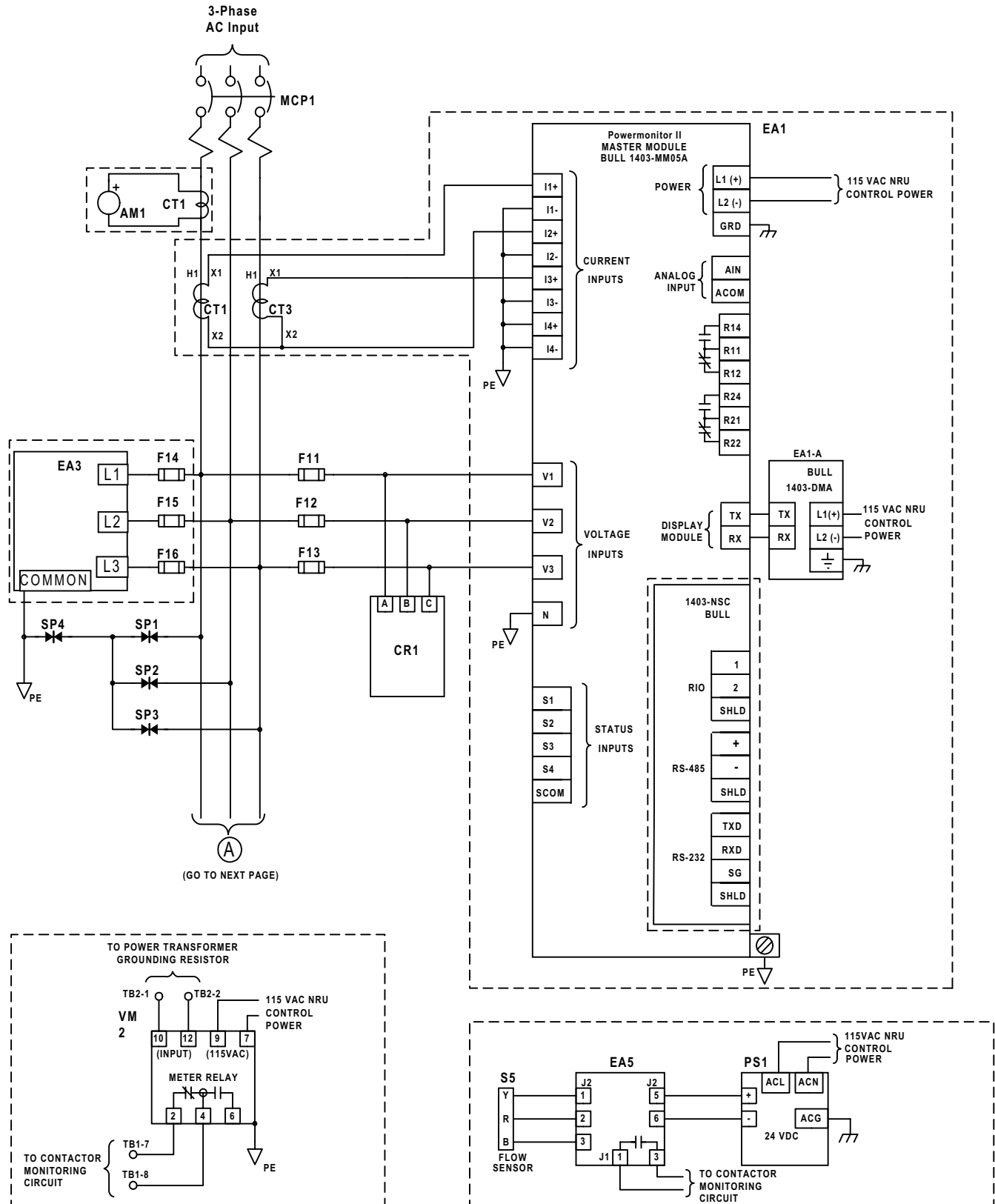
This chapter provides the following information for the 180A DC NRU:

- a typical cabinet layout diagram (Figure 2.1)
- a typical electrical schematic (Figure 2.2)
- a symbol-to-component reference table for interpreting the electrical schematic (Table 2.A)

180A DC System Layout

Figure 2.1
Typical 180A DC NRU Layout



180A DC NRU Electrical Schematic**Figure 2.2
Typical 180A DC NRU Schematic**

Important: The Powermonitor II standard configuration works with grounded-wye secondary supplies only. For more information on Powermonitor II configurations for other supply types, consult Powermonitor II documentation and the Power Quality and Automation group located in Milwaukee, WI, USA.

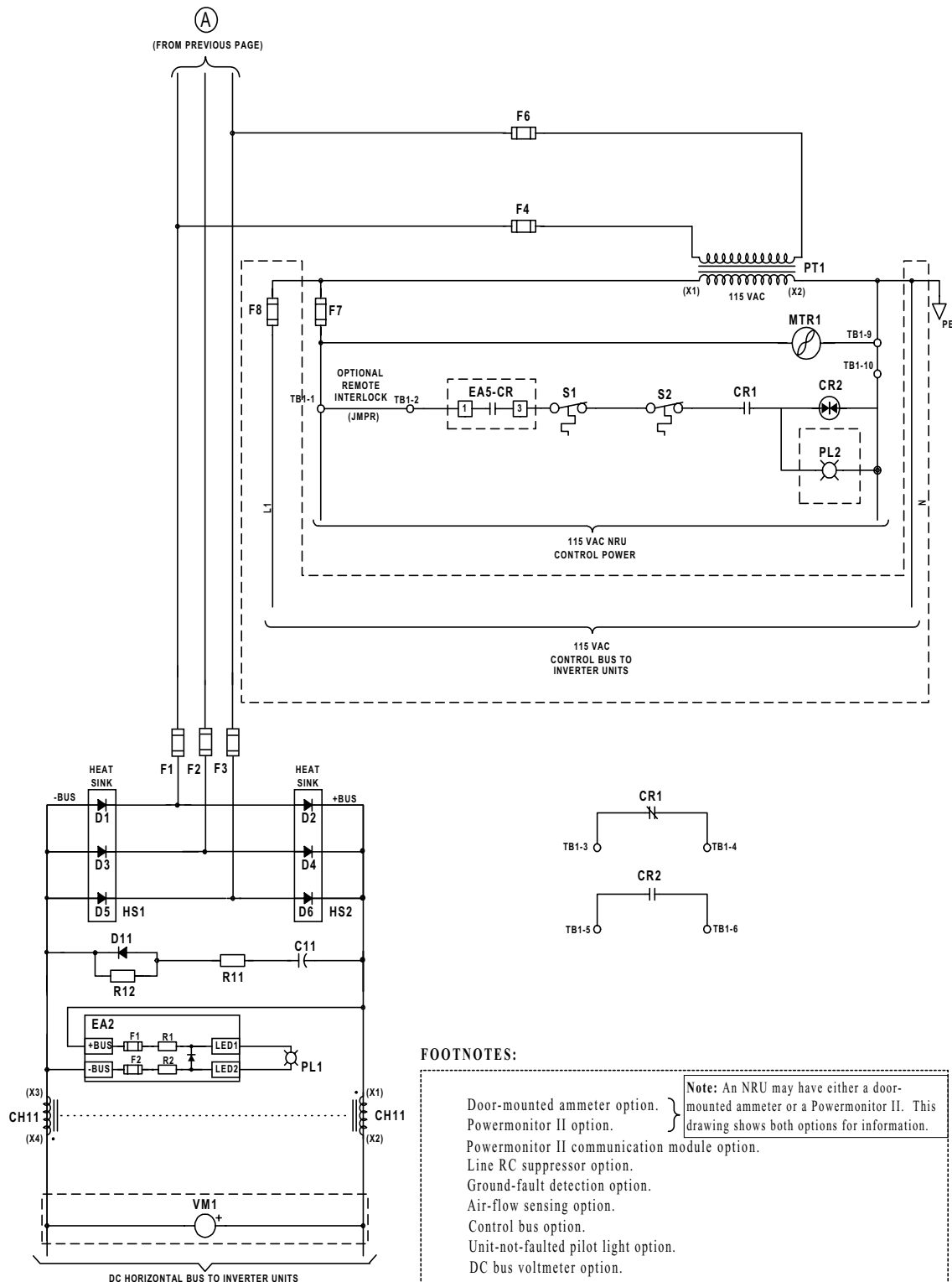


Table 2.A: 180A DC NRU Symbol-to-Component Cross Reference

Symbol	Description	Option	AC 3-Phase Input Voltage			
			230V AC	380V AC	460V AC	575V AC
AM1	Ammeter monitoring L1		200A			
C11	Bridge suppressor capacitor		3 uF, 2000V			
CH11	DC choke		611 uH			
CR1	Phase-loss relay					
CR2	Fault relay					
CT1, CT3	Current transformer		200:5			
D1 - 6	Diodes		450A, 1800V AC			
D11	Bridge suppressor diode		60A, 1700V			
EA1	Powermonitor II					
EA2	Bus indicator PCB					
EA2F1 - 2	Bus indicator PCB fuses		1A, 1000V, HVR, 1-3/32" diameter, 3" length, 500AIC			
EA3	AC line RC suppressor PCB					
EA5	Air flow sensor PCB					
F1 - 3	Incoming 3-phase, line fuses		250A, 170M			
F4, F6	Primary fuse for a 1 kVA control transformer		6.25A, KLDR	4A, KLDR	3A, KLDR	3A, KLDR
	Primary fuse for a 2 kVA control transformer		12A, KLDR	8A, KLDR	6.25A, KLDR	5A, KLDR
	Primary fuse for a 5 kVA control transformer		30A, KLDR	17.5A, KLDR	15A, KLDR	12A, KLDR
F7	NRU control power fuse		2A, KLDR			
F8	Control bus fuse for a 1 kVA control transformer		6A, KLDR			
	Control bus fuse for a 2 kVA control transformer		15A, KLDR			
	Control bus fuse for a 5 kVA control transformer		35A, FRN			
F11 - 13	Phase-loss fuses		1A, KLDR			
F14 - 16	RC suppressor fuses		25A, KTKR			
HS1 - 2	Bridge heatsink					
MCP1	Motor circuit protector		250A, J-frame			
MTR1	Bridge fan		560 CFM			
MTR1-C	Bridge fan capacitor		10 uF capacitor			
PL1	DC-Bus-Energized pilot light		24V AC/VDC, red, 800MR			
PL2	Unit-Not-Faulted pilot light		120V AC, amber, 800MR			
PS1	Air flow sensor power supply		24V DC, 0.5A			
PT1	Control power transformer		A 1 kVA control transformer is standard, 2 kVA and 5 kVA control transformers are available as options. This transformer has multiple taps to accommodate 230, 380, 460, 575V AC primary voltages.			
R11	Bridge suppressor resistor		2.2 ohm, 100 W			
R12	Bridge suppressor resistor		100 ohm, 100 W			
S1 - 2	Heatsink thermoswitch		210 °F			
S5	Air flow switch					
SP1 - 3	Line-to-line MOVs		360 J, 275V AC	460 J, 320V AC	460 J, 320V AC	550 J, 385V AC
SP4	Neutral-to-ground MOV		600 J, 550V AC	760 J, 680V AC	760 J, 680V AC	760 J, 680V AC
VM1	DC bus voltmeter		750V DC	750V DC	1000V DC	1000V DC
VM2	Ground fault detector					

Components marked as being options are part of NRU standard options. Not all NRUs will have these components.

Your 350A DC NRU (Current Code B)

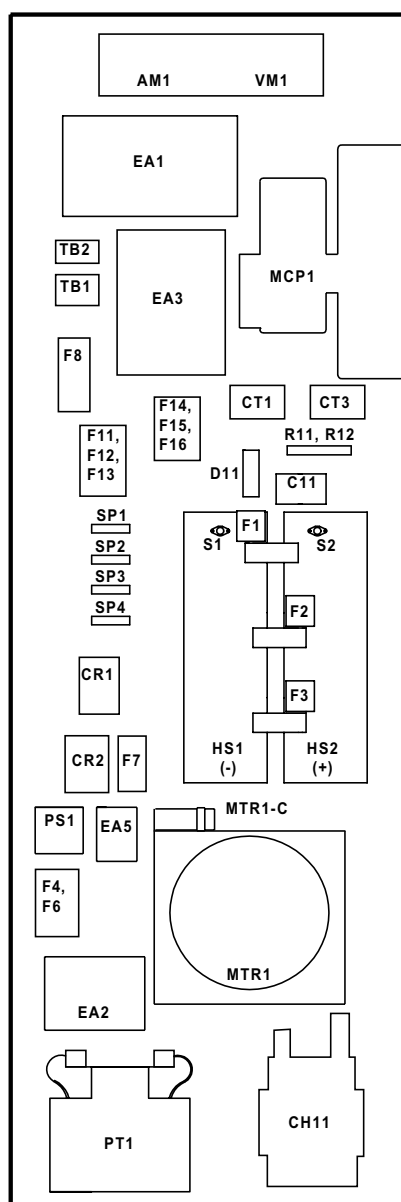
Input Voltage (V AC)	Rated DC Bus kW
230	109
380	179
460	217
575	271

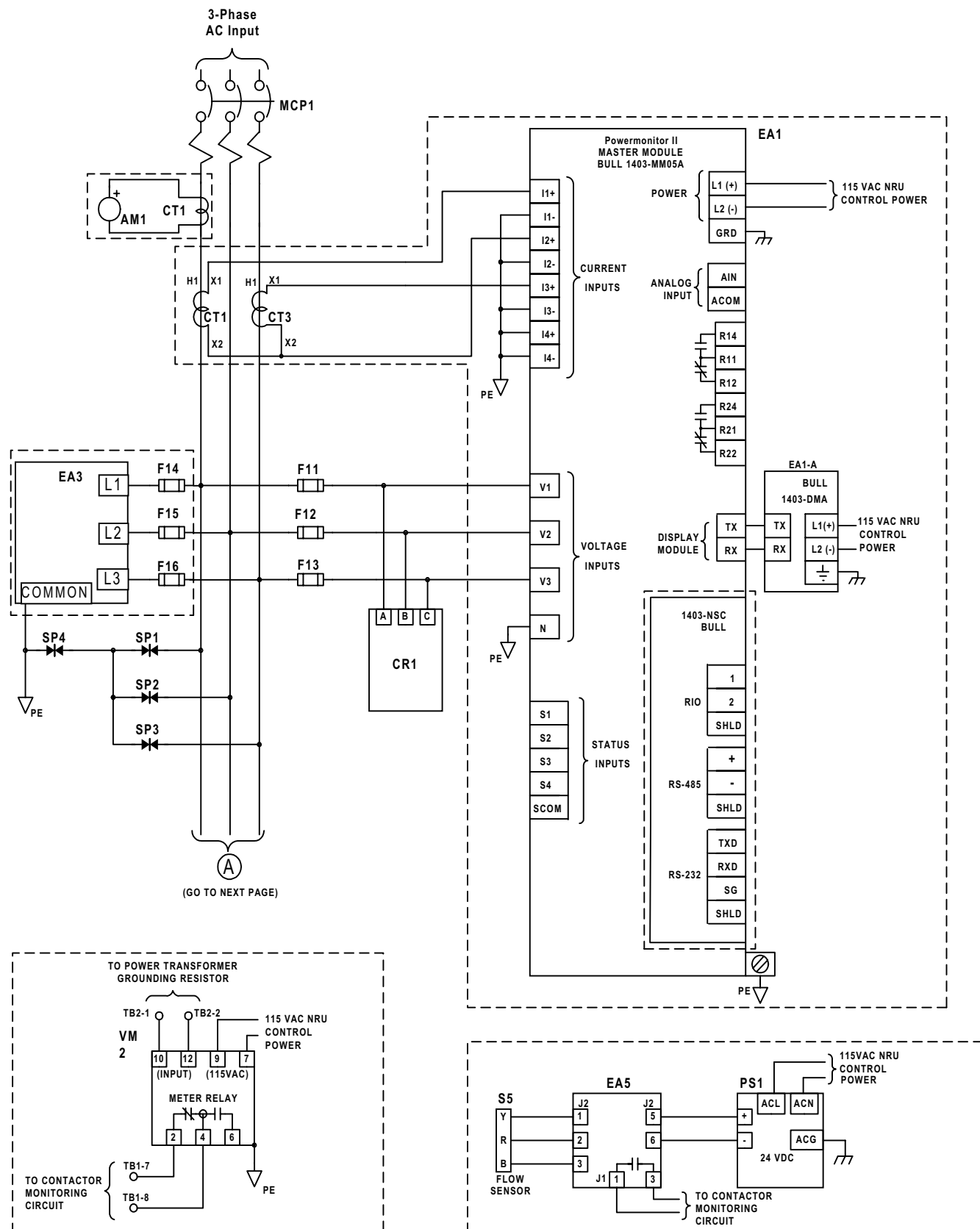
This chapter provides the following information for the 350A DC NRU:

- a typical cabinet layout diagram (Figure 3.1)
- a typical electrical schematic (Figure 3.2)
- a symbol-to-component reference table for interpreting the electrical schematic (Table 3.A)

350A DC System Layout

Figure 3.1
Typical 350A DC NRU Layout



350A DC NRU Electrical Schematic**Figure 3.2
Typical 350A DC NRU Schematic**

[illegible]

Table 3.A: 350A DC NRU Symbol-to-Component Cross Reference

Symbol	Description	Option	AC 3-Phase Input Voltage			
			230V AC	380V AC	460V AC	575V AC
AM1	Ammeter monitoring L1		400A			
C11	Bridge suppressor capacitor		32 uF, 2000V			
CH11	DC choke		319 uH			
CR1	Phase-loss relay					
CR2	Fault relay					
CT1, CT3	Current transformer		400:5			
D1 - 6	Diodes		450A, 1800V AC			
D11	Bridge suppressor diode		60A, 1700V			
EA1	Powermonitor II					
EA2	Bus indicator PCB					
EA2F1 - 2	Bus indicator PCB fuses		1A, 1000V, HVR, 1-3/32" diameter, 3" length, 500AIC			
EA3	AC line RC suppressor PCB					
EA5	Air flow sensor PCB					
F1 - 3	Incoming 3-phase, line fuses		450A, 170M fuse			
F4, F6	Primary fuse for a 1 kVA control transformer		6.25A, KLDR	4A, KLDR	3A, KLDR	3A, KLDR
	Primary fuse for a 2 kVA control transformer		12A, KLDR	8A, KLDR	6.25A, KLDR	5A, KLDR
	Primary fuse for a 5 kVA control transformer		30A, KLDR	17.5A, KLDR	15A, KLDR	12A, KLDR
F7	NRU control power fuse		2A, KLDR			
F8	Control bus fuse for a 1 kVA control transformer		6A, KLDR			
	Control bus fuse for a 2 kVA control transformer		15A, KLDR			
	Control bus fuse for a 5 kVA control transformer		35A, FRN			
F11 - 13	Phase-loss fuses		1A, KLDR			
F14 - 16	RC suppressor fuses		25A, KTKR			
HS1 - 2	Bridge heatsink					
MCP1	Motor circuit protector		400A, K-frame			
MTR1	Bridge fan		560 CFM			
MTR1-C	Bridge fan capacitor		10 uF capacitor			
PL1	DC-Bus-Energized pilot light		24V AC/VDC, red, 800MR			
PL2	Unit-Not-Faulted pilot light		120V AC, amber, 800MR			
PS1	Air flow sensor power supply		24V DC, 0.5A			
PT1	Control power transformer		A 1 kVA control transformer is standard, 2 kVA and 5 kVA control transformers are available as options. This transformer has multiple taps to accommodate 230, 380, 460, 575V AC primary voltages.			
R11	Bridge suppressor resistor		2.2 ohm, 100 W			
R12	Bridge suppressor resistor		100 ohm, 100 W			
S1 - 2	Heatsink thermoswitch		210 °F			
S5	Air flow switch					
SP1 - 3	Line-to-line MOVs		360 J, 275V AC	460 J, 320V AC	460 J, 320V AC	550 J, 385V AC
SP4	Neutral-to-ground MOV		600 J, 550V AC	760 J, 680V AC	760 J, 680V AC	760 J, 680V AC
VM1	DC bus voltmeter		750V DC	750V DC	1000V DC	1000V DC
VM2	Ground fault detector					

Components marked as being options are part of NRU standard options. Not all NRUs will have these components.

Your 900A DC NRU (Current Code C)

Input Voltage (V AC)	Rated DC Bus kW
230	279
380	459
460	558
575	698

This chapter provides the following information for the 900A DC NRU:

- a typical cabinet layout diagram (Figure 4.1)
- a typical electrical schematic (Figure 4.2)
- a symbol-to-component reference table for interpreting the electrical schematic (Table 4.A)

900A DC System Layout

Figure 4.1
Typical 900A DC NRU Layout

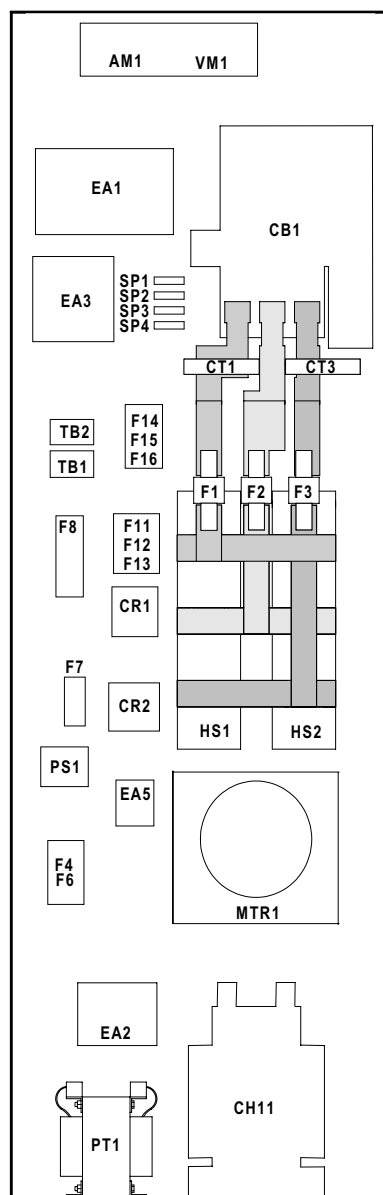
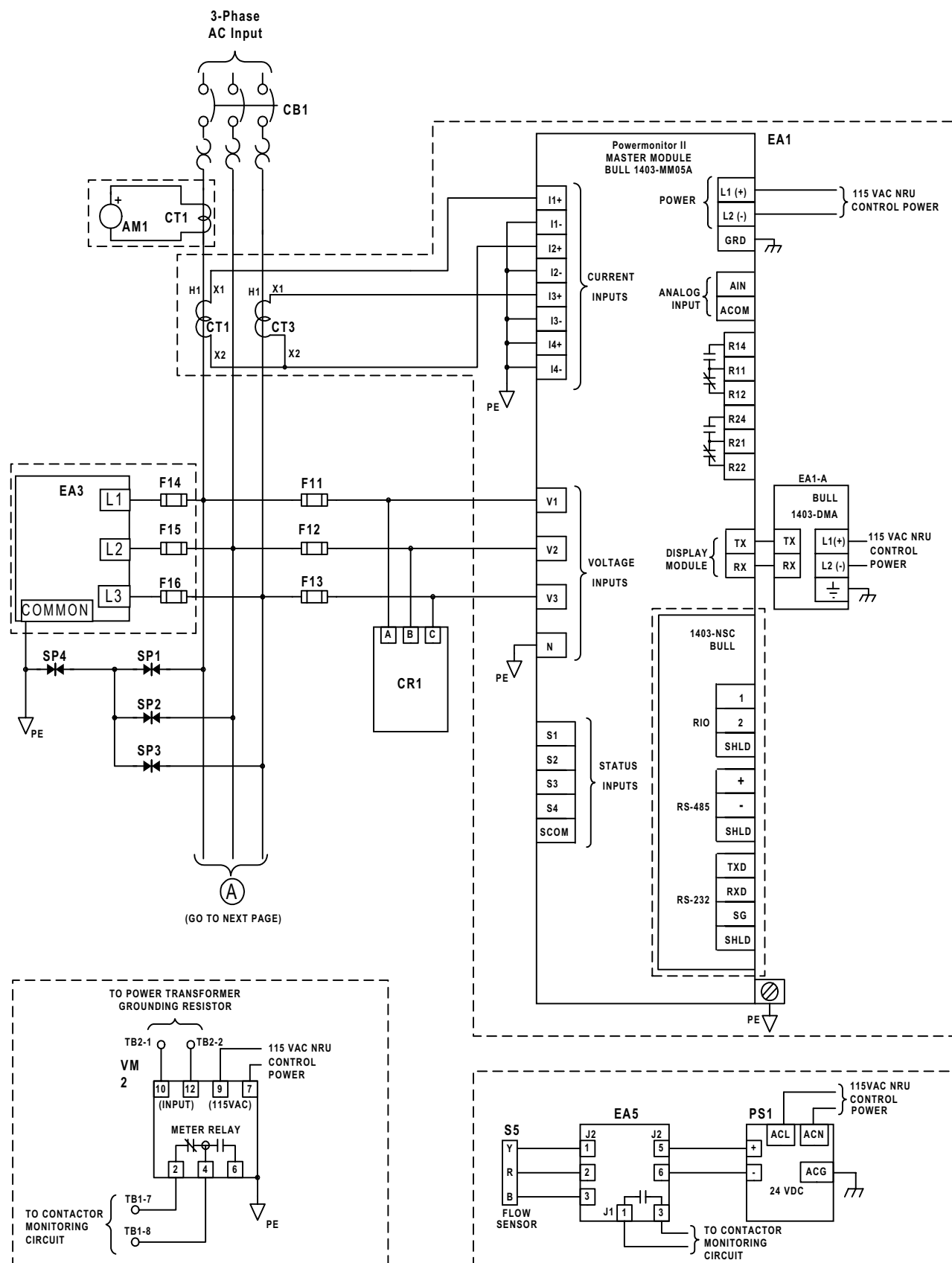


Figure 4.2 Typical 900A DC NRU Schematic



Important: The Powermonitor II standard configuration works with grounded-wye secondary supplies only. For more information on Powermonitor II configurations for other supply types, consult Powermonitor II documentation and the Power Quality and Automation group located in Milwaukee, WI, USA.

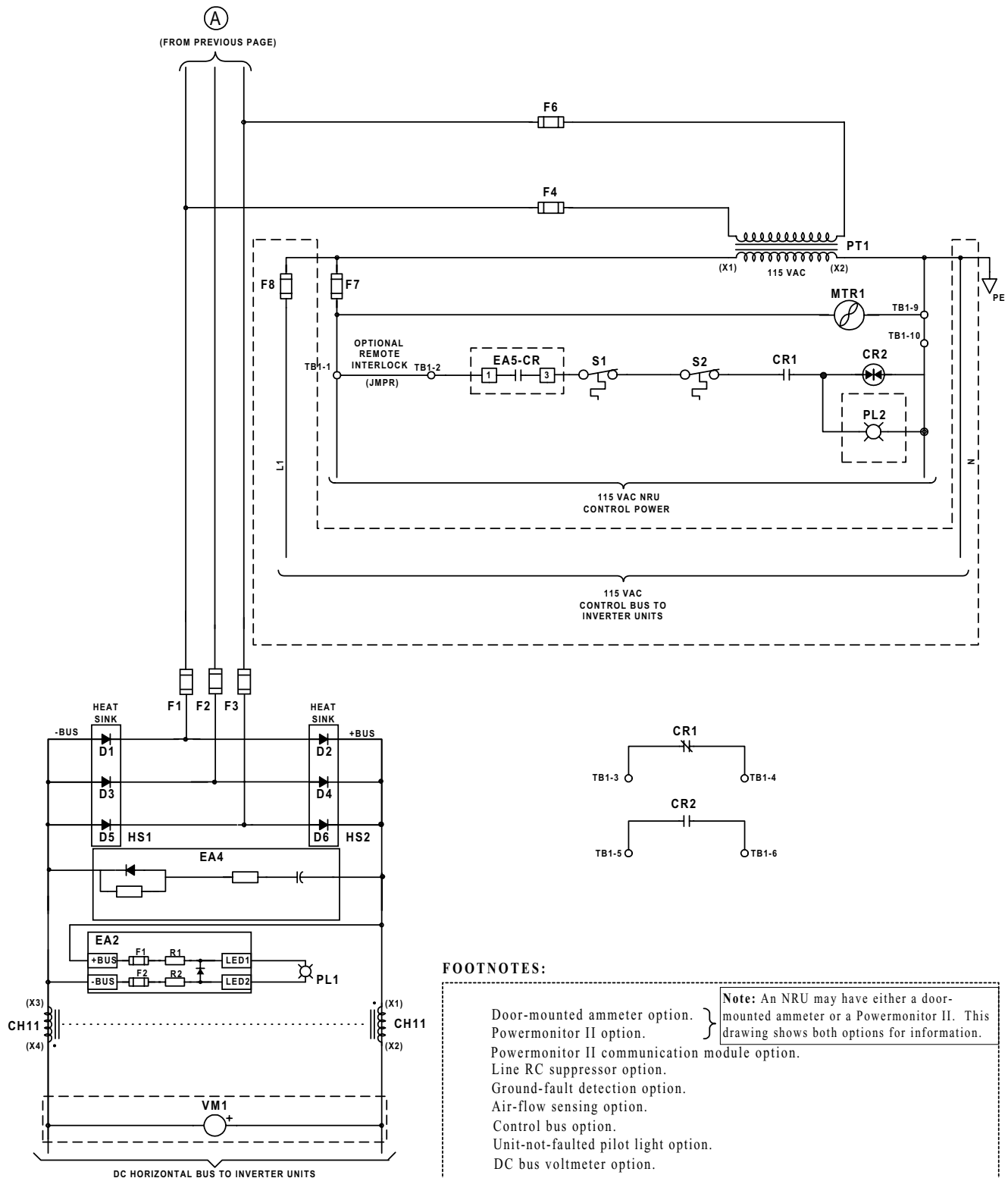


Table 4.A: 900A DC NRU Symbol-to-Component Cross Reference

Symbol	Description	Option	AC 3-Phase Input Voltage			
			230V AC	380V AC	460V AC	575V AC
AM1	Ammeter monitoring L1		1000A			
CB1	Circuit Breaker		1200A R-frame breaker with 1200A plug			
CH11	DC choke		124 uH			
CR1	Phase-loss relay					
CR2	Fault relay					
CT1, CT3	Current transformer		1000:5			
D1 - 6	Diodes		900A, 1800V AC			
EA1	Powermonitor II					
EA2	Bus indicator PCB					
EA2F1 - 2	Bus indicator PCB fuses		1A, 1000V, HVR, 1-3/32" diameter, 3" length, 500AIC			
EA3	AC line RC suppressor PCB					
EA4	Bridge suppressor PCB					
EA5	Air flow sensor PCB					
F1 - 3	Incoming 3-phase, line fuses		1000A, 170M			
F4, F6	Primary fuse for a 1 kVA control transformer		6.25A, KLDR	4A, KLDR	3A, KLDR	3A, KLDR
	Primary fuse for a 2 kVA control transformer		12A, KLDR	8A, KLDR	6.25A, KLDR	5A, KLDR
	Primary fuse for a 5 kVA control transformer		30A, KLDR	17.5A, KLDR	15A, KLDR	12A, KLDR
F7	NRU control power fuse		3A, KLDR			
F8	Control bus fuse for a 1 kVA control transformer		5A, KLDR			
	Control bus fuse for a 2 kVA control transformer		12A, KLDR			
	Control bus fuse for a 5 kVA control transformer		35A, FRN			
F11 - 13	Phase-loss fuses		1A, KLDR			
F14 - 16	RC suppressor fuses		25A, KTKR			
HS1 - 2	Bridge heatsink					
MTR1	Bridge fan		710 CFM			
MTR1-C	Bridge fan capacitor		16 uF capacitor			
PL1	DC-Bus-Energized pilot light		24V AC/VDC, red, 800MR			
PL2	Unit-Not-Faulted pilot light		120V AC, amber, 800MR			
PS1	Air flow sensor power supply		24V DC, 0.5A			
PT1	Control power transformer		A 1 kVA control transformer is standard, 2 kVA and 5 kVA control transformers are available as options. This transformer has multiple taps to accommodate 230, 380, 460, 575V AC primary voltages.			
S1 - 2	Heatsink thermoswitch		210 °F			
S5	Air flow switch					
SP1 - 3	Line-to-line MOVs		360 J, 275V AC	460 J, 320V AC	460 J, 320V AC	550 J, 385V AC
SP4	Neutral-to-ground MOV		600 J, 550V AC	760 J, 680V AC	760 J, 680V AC	760 J, 680V AC
VM1	DC bus voltmeter		750V DC	750V DC	1000V DC	1000V DC
VM2	Ground fault detector					

Components marked as being options are part of NRU standard options. Not all NRUs will have these components.

Your 1500A DC NRU (Current Code D)

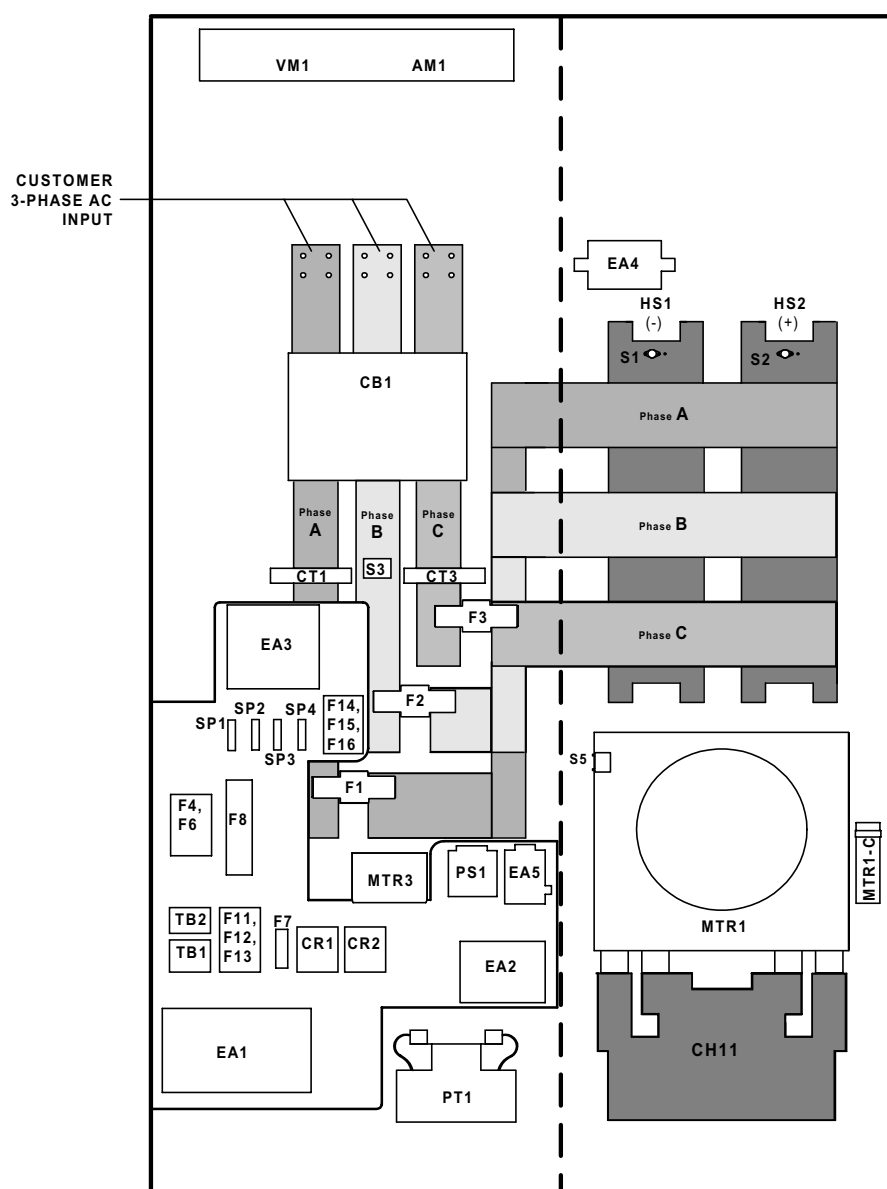
Input Voltage (V AC)	Rated DC Bus kW
230	465
380	765
460	930
575	1163

This chapter provides the following information for the 1500A DC NRU:

- a typical cabinet layout diagram (Figure 5.1)
- a typical electrical schematic (Figure 5.2)
- a symbol-to-component reference table for interpreting the electrical schematic (Table 5.A)

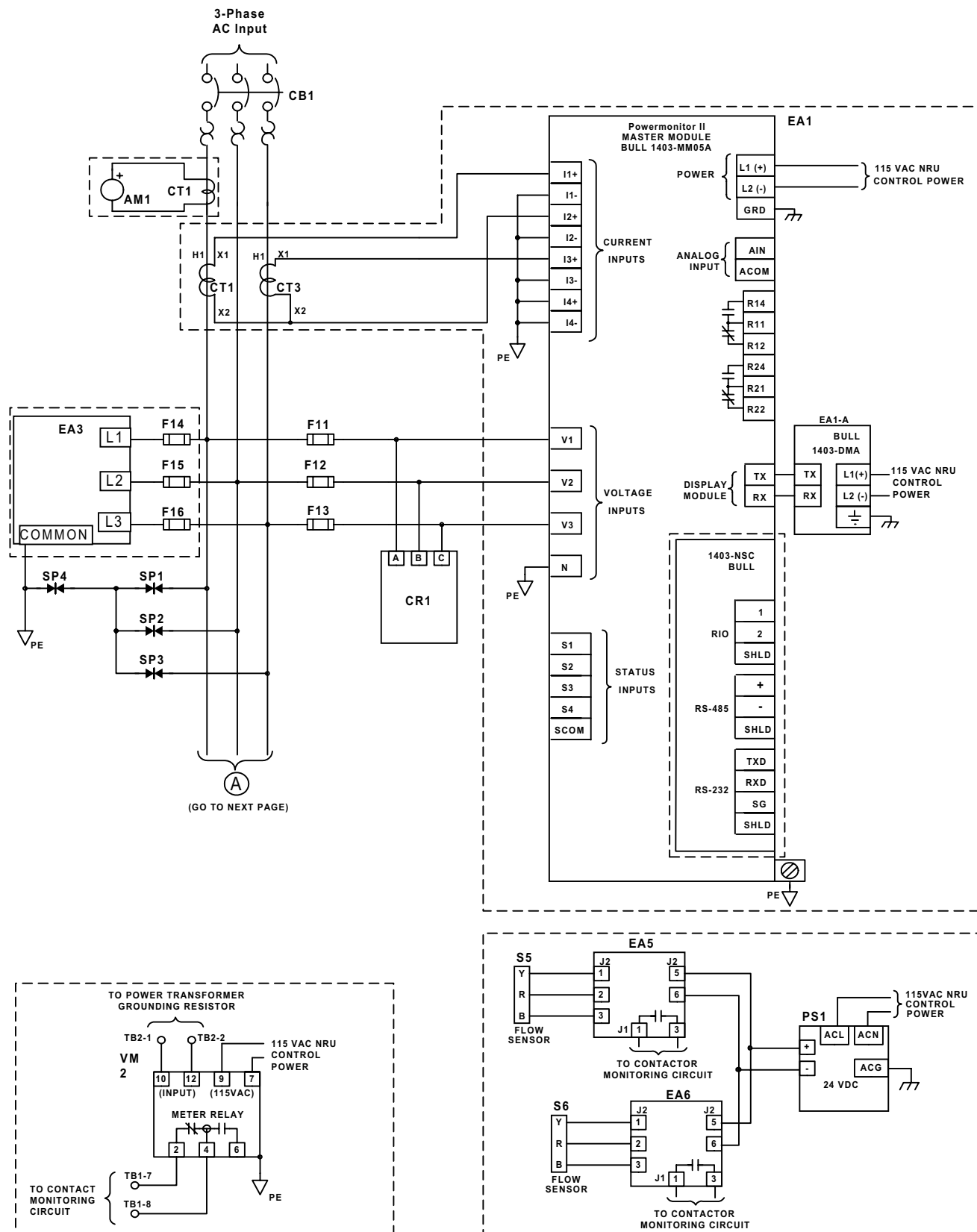
1500A DC System Layout

Figure 5.1
Typical 1500A DC NRU Layout



1500A DC NRU Electrical Schematic

Figure 5.2
Typical 1500A DC NRU Schematic



The diagram shows the electrical connections from the previous page to various components. It includes two main sections:

- Top Section (Control Bus and Power Distribution):** This section shows the connection of three-phase AC power (L1, L2, L3) through fuses F1, F2, and F3 to a DC horizontal bus. The bus is connected to several components:
 - A transformer PT1 providing 115 VAC to meters MTR1 and MTR2.
 - An optional remote interlock circuit (JMPR) involving relays EA5-CR and EA6-CR, switches S1, S2, S3, and CR1, and a pilot light PL2.
 - A 115 VAC NRU (Not-Rated Unit) control power source.
 - A 115 VAC control bus to inverter units.
- Bottom Section (DC Horizontal Bus to Inverter Units):** This section shows the DC bus connected to a series of diodes (D1-D6) and heat sinks (HS1, HS2). It also includes a power monitor module VM1 and a communication module CH11-TG. A note indicates that the drawing shows both options for information.

Footnotes:

- Door-mounted ammeter option.
- Powermonitor II option.
- Powermonitor II communication module option.
- Line RC suppressor option.
- Ground-fault detection option.
- Air-flow sensing option.
- Control bus option.
- Unit-not-faulted pilot light option.
- DC bus voltmeter option.

Note: An NRU may have either a door-mounted ammeter or a Powermonitor II. This drawing shows both options for information.

Table 5.A: 1500A DC NRU Symbol-to-Component Cross Reference

Symbol	Description	Option	AC 3-Phase Input Voltage			
			230V AC	380V AC	460V AC	575V AC
AM1	Ammeter monitoring L1		1500A			
CB1	Circuit breaker		2000A R-frame breaker with 1600A plug			
CH11	DC choke		72 uH			
CH11-TG	DC choke thermoswitch					
CR1	Phase-loss relay					
CR2	Fault relay					
CT1, CT3	Current transformer		1500:5			
D1 - 6	Diodes		1960A, 1800V AC			
EA1	Powermonitor II					
EA2	Bus indicator PCB					
EA2F1 - 2	Bus indicator PCB fuses		1A, 1000V, HVR, 1-3/32" diameter, 3" length, 500AIC			
EA3	Line RC suppressor PCB					
EA4	Bridge suppressor PCB					
EA5 - 6	Air flow sensor PCB					
F1 - 3	Incoming 3-phase, line fuses		1500A, 170M			
F4, F6	Primary fuse for a 1 kVA control transformer		6.25A, KLDR	4A, KLDR	3A, KLDR	3A, KLDR
	Primary fuse for a 5 kVA control transformer		30A, KLDR	17.5A, KLDR	15A, KLDR	12A, KLDR
	Primary fuse for a 10 kVA control transformer		60A, KLDR	35A, FRS	25A, KLDR	20A, KLDR
F7	NRU control power fuse		4A, KLDR			
F8	Control bus fuse for a 1 kVA control transformer		4A, KLDR			
	Control bus fuse for a 5 kVA control transformer		35A, FRN			
	Control bus fuse for a 10 kVA control transformer		75A, FRN			
F11 - 13	Phase-loss fuses		1A, KLDR			
F14 - 16	RC suppressor fuses		25A, KTKR			
HS1 - 2	Bridge heatsink					
MTR1	Bridge fan		1200 CFM			
MTR1-C	Bridge fan capacitor		20 uF capacitor			
MTR2	Door-mounted fan by choke		6.9", 340 CFM			
PL1	DC-Bus-Energized pilot light		24V AC/VDC, red, 800MR			
PL2	Unit-Not-Faulted pilot light		120V AC, amber, 800MR			
PS1	Air flow sensor power supply		24V DC, 1.1A			
PT1	Control power transformer		A 1 kVA control transformer is standard, 5 kVA and 10 kVA control transformers are available as options. This transformer has multiple taps to accommodate 230, 380, 460, 575V AC primary voltages.			
S1 - 2	Heatsink thermoswitch		210 °F			
S3	Choke thermoswitch					
S5	Air flow sensor					
SP1 - 3	Line-to-line MOVs		360 J, 275V AC	460 J, 320V AC	460 J, 320V AC	550 J, 385V AC
SP4	Neutral-to-ground MOV		600 J, 550V AC	760 J, 680V AC	760 J, 680V AC	760 J, 680V AC
VM1	DC bus voltmeter		750V DC	750V DC	750V DC	1000V DC
VM2	Ground fault detector					

Components marked as being options are part of NRU standard options. Not all NRUs will have these components.

Your 2000A DC NRU (Current Code E)

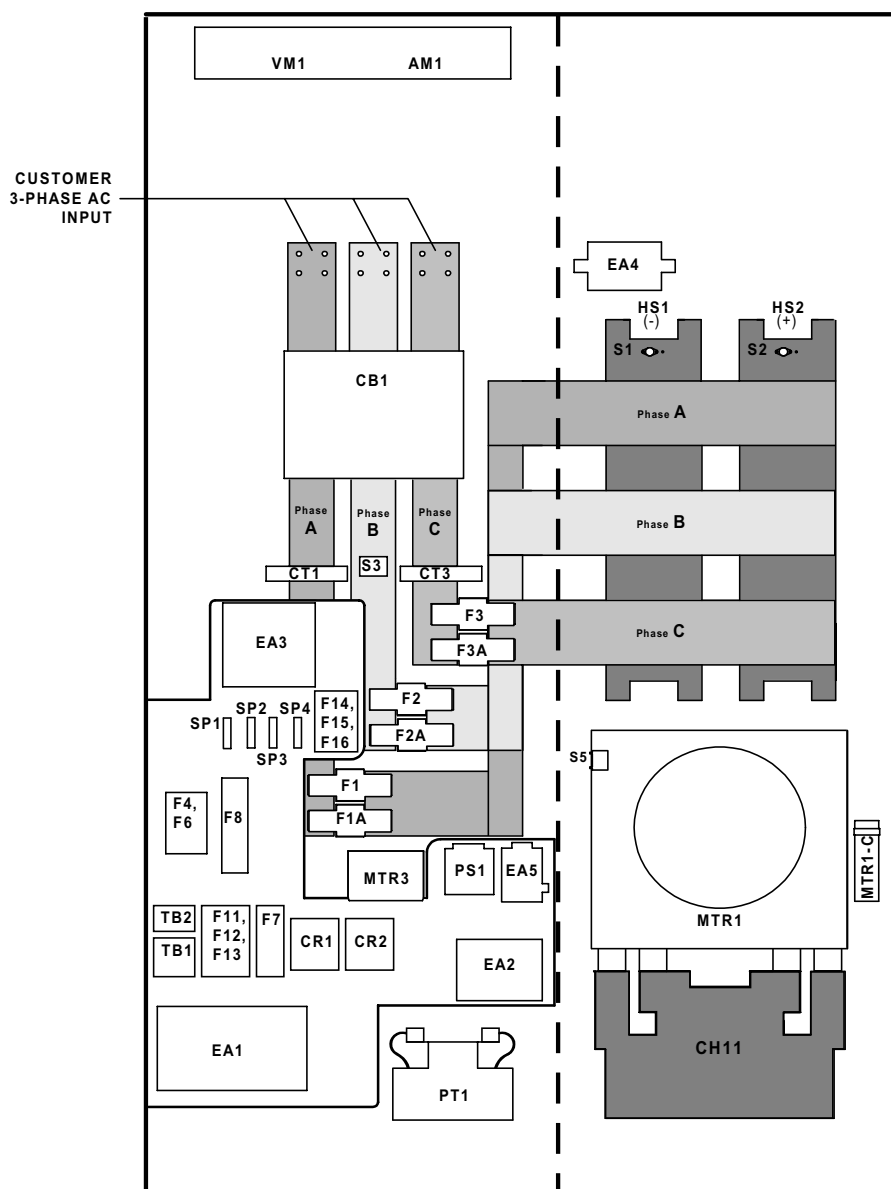
Input Voltage (V AC)	Rated DC Bus kW
230	620
380	1020
460	1240
575	1550

This chapter provides the following information for the 2000A DC NRU:

- a typical cabinet layout diagram (Figure 6.1)
- a typical electrical schematic (Figure 6.2)
- a symbol-to-component reference table for interpreting the electrical schematic (Table 6.A)

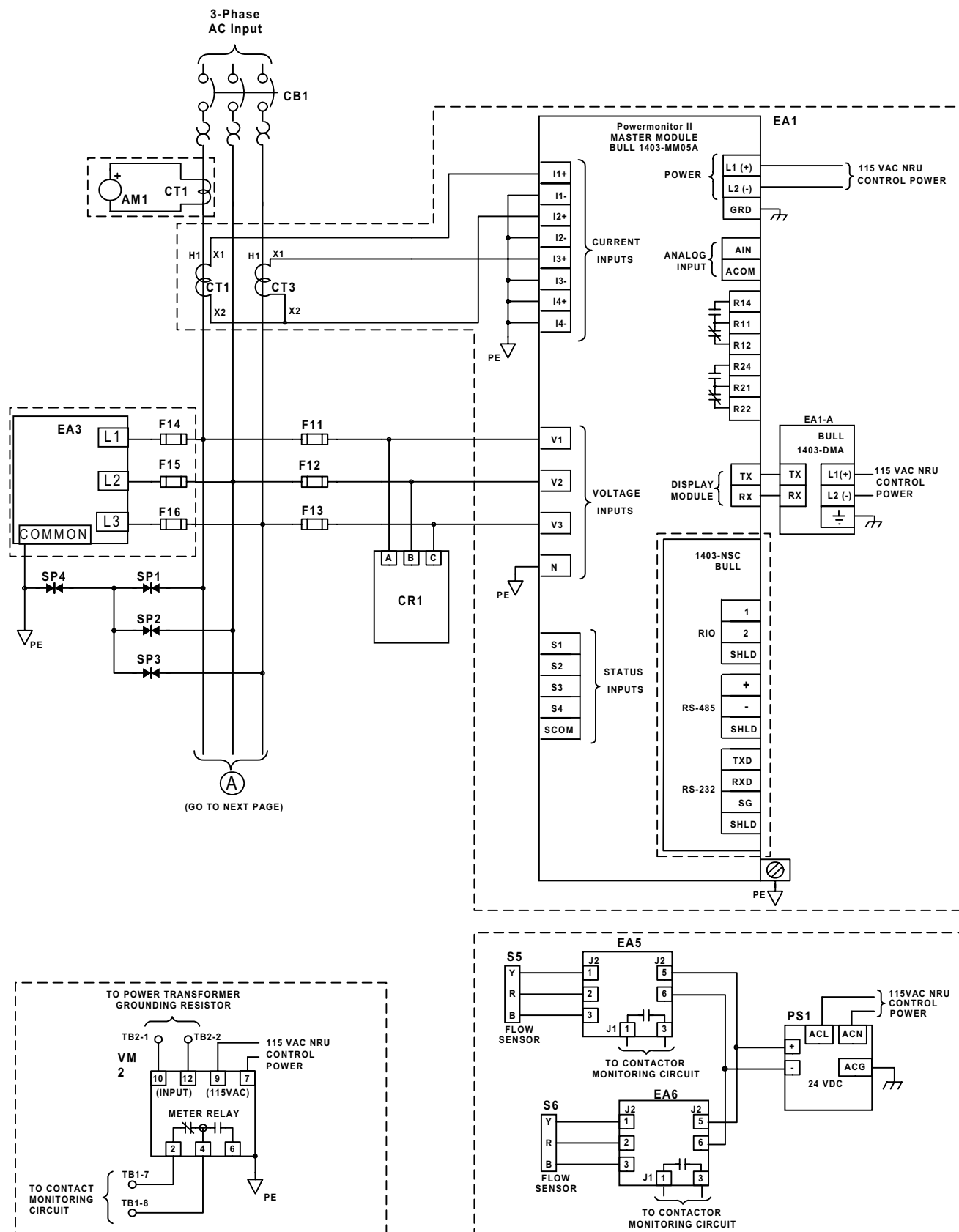
2000A DC System Layout

Figure 6.1
Typical 2000A DC NRU Layout



2000A DC NRU Electrical Schematic

Figure 6.2
Typical 2000A DC NRU Schematic



(FROM PREVIOUS PAGE)

F6
F4

PT1
(X1) 115 VAC (X2)

MTR1
MTR2, MTR3

TB1-9
TB1-10

OPTIONAL REMOTE INTERLOCK (JMPR)
TB1-1 TB1-2

EA5-CR EA6-CR

CH11-TG S3

S1 S2 CR1 CR2

PL2

115 VAC NRU CONTROL POWER

115 VAC CONTROL BUS TO INVERTER UNITS

F1 F2 F3 F3A
F1A F2A

HEAT SINK
-BUS +BUS

D1 D2
D3 D4
D5 D6

HS1 HS2

EA4

EA2
+BUS -BUS
F1 F2 R1 R2 LED1 LED2
PL1

CH11
(X3) (X4)

VM1

DC HORIZONTAL BUS TO INVERTER UNITS

CR1
TB1-3 TB1-4

CR2
TB1-5 TB1-6

FOOTNOTES:

Door-mounted ammeter option.
Powermonitor II option.
Powermonitor II communication module option.
Line RC suppressor option.
Ground-fault detection option.
Air-flow sensing option.
Control bus option.
Unit-not-faulted pilot light option.
DC bus voltmeter option.

Note: An NRU may have either a door-mounted ammeter or a Powermonitor II. This drawing shows both options for information.

Table 6.A: 2000A DC NRU Symbol-to-Component Cross Reference

Symbol	Description	Option	AC 3-Phase Input Voltage			
			230V AC	380V AC	460V AC	575V AC
AM1	Ammeter monitoring L1		2000A			
CB1	Circuit breaker		2000A R-frame breaker with 2000A plug			
CH11	DC choke		56 uH			
CH11-TG	DC choke thermoswitch					
CR1	Phase-loss relay					
CR2	Fault relay					
CT1, CT3	Current transformer		2000:5			
D1 - 6	Diodes		1960A, 1800V AC			
EA1	Powermonitor II					
EA2	DC Bus indicator PCB					
EA2F1 - 2	DC Bus indicator PCB fuses		1A, 1000V, HVR, 1-3/32" diameter, 3" length, 500AIC			
EA3	Line RC suppressor PCB					
EA4	Bridge suppressor PCB					
EA5 - 6	Air flow sensor PCB					
F1 - 3, F1A-3A	Incoming 3-phase, line fuses		1000A, 170M			
F4, F6	Primary fuse for a 1 kVA control transformer		6.25A, KLDR	4A, KLDR	3A, KLDR	3A, KLDR
	Primary fuse for a 5 kVA control transformer		30A, KLDR	17.5A, KLDR	15A, KLDR	12A, KLDR
	Primary fuse for a 10 kVA control transformer		60A, KLDR	35A, FRS	25A, KLDR	20A, KLDR
F7	NRU control power fuse		5A, KLDR			
F8	Control bus fuse for a 1 kVA control transformer		4A, KLDR			
	Control bus fuse for a 5 kVA control transformer		35A, FRN			
	Control bus fuse for a 10 kVA control transformer		75A, FRN			
F11 - 13	Phase-loss fuses		1A, KLDR			
F14 - 16	RC suppressor fuses		25A, KTKR			
HS1 - 2	Bridge heatsink					
MTR1	Bridge fan		1200 CFM			
MTR1-C	Bridge fan capacitor		20 uF capacitor			
MTR2 - 3	Door-mounted fan by choke		6.9", 340 CFM			
PL1	DC-Bus-Energized pilot light		24V AC/VDC, red, 800MR			
PL2	Unit-Not-Faulted pilot light		120V AC, amber, 800MR			
PS1	Air flow sensor power supply		24V DC, 1.1A			
PT1	Control power transformer		A 1 kVA control transformer is standard, 5 kVA and 10 kVA control transformers are available as options. This transformer has multiple taps to accommodate 230, 380, 460, 575V AC primary voltages.			
S1 - 2	Heatsink thermoswitch		210 °F			
S3	Choke thermoswitch					
S5	Air flow sensor					
SP1 - 3	Line-to-line MOVs		360 J, 275V AC	460 J, 320V AC	460 J, 320V AC	550 J, 385V AC
SP4	Neutral-to-ground MOV		600 J, 550V AC	760 J, 680V AC	760 J, 680V AC	760 J, 680V AC
VM1	DC bus voltmeter		750V DC	750V DC	1000V DC	1000V DC
VM2	Ground fault detector					

Components marked as being options are part of NRU standard options. Not all NRUs will have these components.

Your 2500A DC NRU (Current Code F)

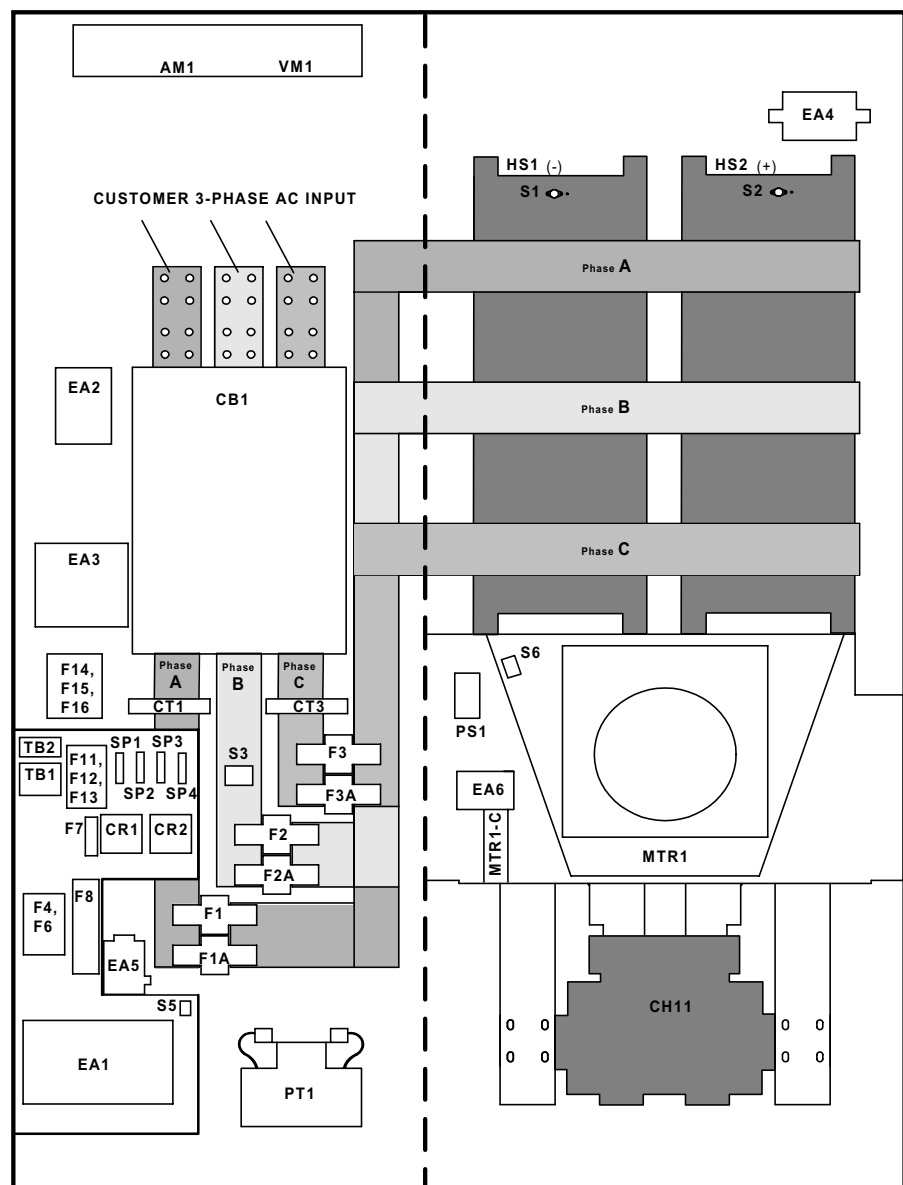
Input Voltage (V AC)	Rated DC Bus kW
230	775
380	1275
460	1550
575	1938

This chapter provides the following information for the 2500A DC NRU:

- a typical cabinet layout diagram (Figure 7.1)
- a typical electrical schematic (Figure 7.2)
- a symbol-to-component reference table for interpreting the electrical schematic (Table 7.A)

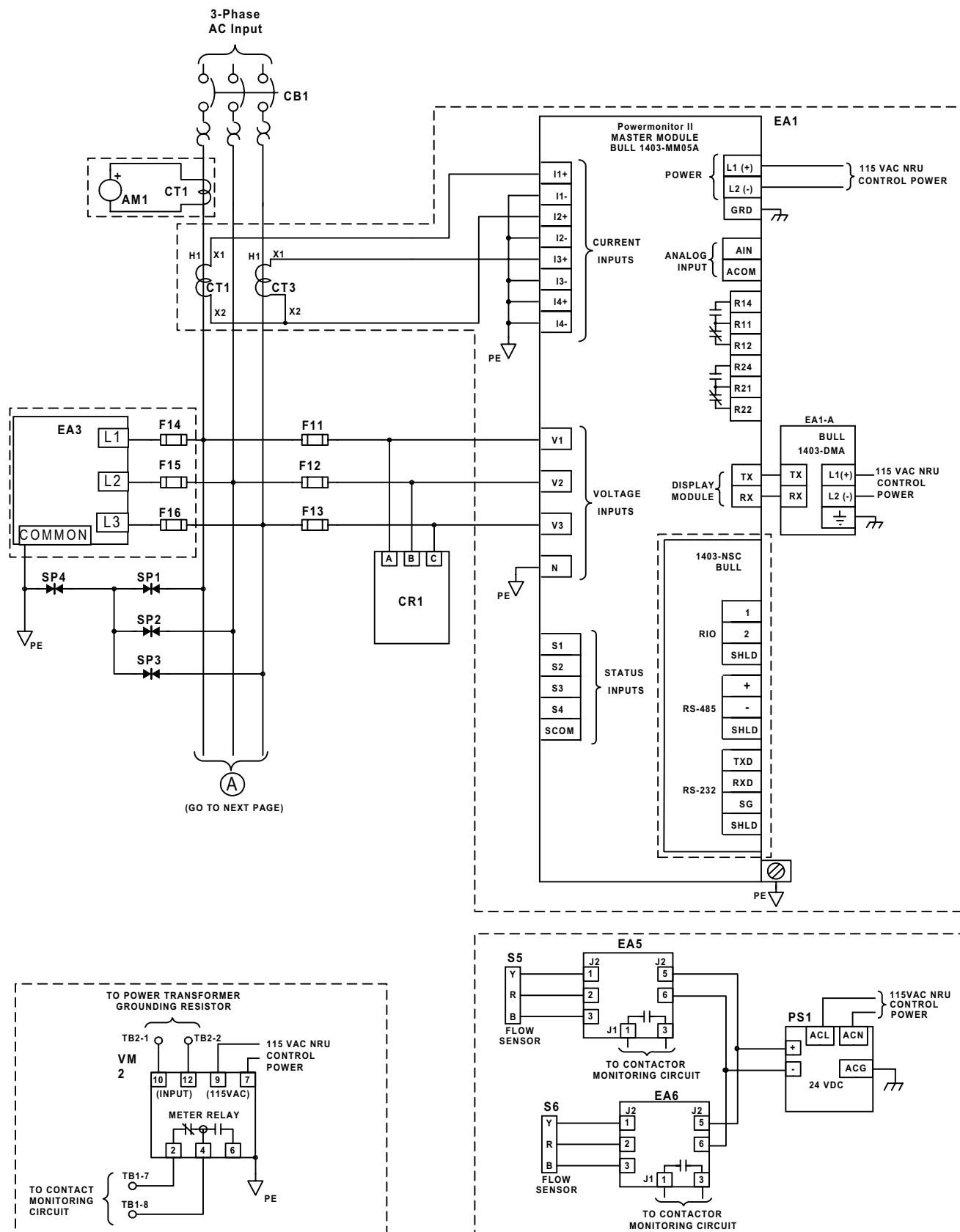
2500A DC System Layout

Figure 7.1
Typical 2500A DC NRU Layout



2500A DC NRU Electrical Schematic

Figure 7.2
Typical 2500A DC NRU Schematic



Important: The Powermonitor II standard configuration works with grounded-wye secondary supplies only. For more information on Powermonitor II configurations for other supply types, consult Powermonitor II documentation and the Power Quality and Automation group located in Milwaukee, WI, USA.

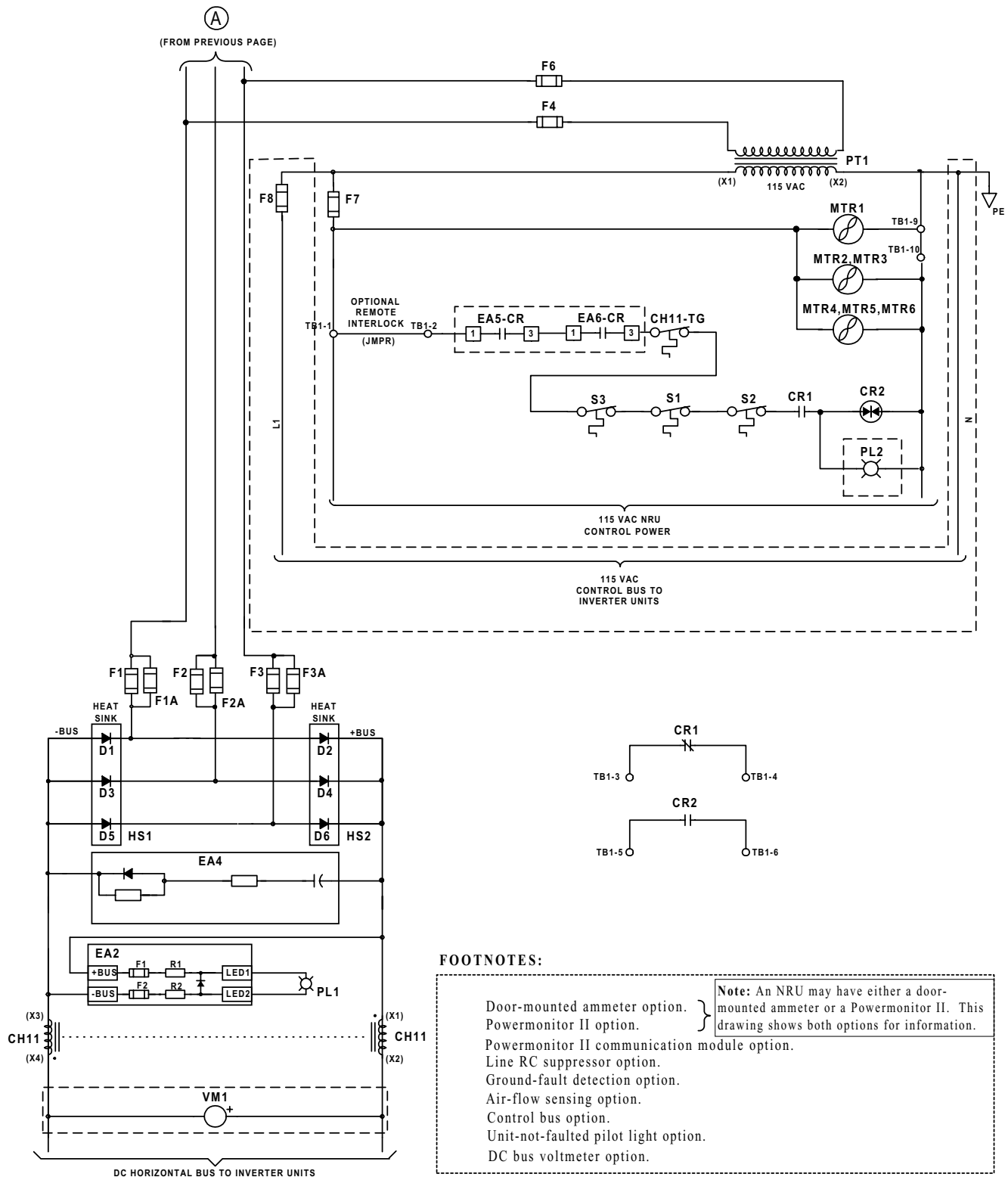


Table 7.A: 2500A DC NRU Symbol-to-Component Cross Reference

Symbol	Description	Option	AC 3-Phase Input Voltage			
			230V AC	380V AC	460V AC	575V AC
AM1	Ammeter monitoring L1		3000A			
CB1	Circuit breaker		3000A R-frame breaker with 2500A plug			
CH11	DC choke		44 uH			
CH11-TG	DC choke thermoswitch					
CR1	Phase-loss relay					
CR2	Fault relay					
CT1, CT3	Current transformer		3000:5			
D1 - 6	Diodes		3000A AC, 1800V AC			
EA1	Powermonitor II					
EA2	Bus indicator PCB					
EA2F1 - 2	Bus indicator PCB fuses		1A, 1000V, HVR, 1-3/32" diameter, 3" length, 500AIC			
EA3	Line RC suppressor PCB					
EA4	Bridge suppressor PCB					
EA5 - 6	Air flow sensor PCB					
F1 - 3, F1A-3A	Incoming 3-phase, line fuses		1250A, 170M			
F4, F6	Primary fuse for a 2 kVA control transformer		12A, KLDR	8A, KLDR	6.25A, KLDR	5A, KLDR
	Primary fuse for a 5 kVA control transformer		30A, KLDR	17.5A, KLDR	15A, KLDR	12A, KLDR
	Primary fuse for a 10 kVA control transformer		60A, KLDR	35A, FRS	25A, KLDR	20A, KLDR
F7	NRU control power fuse		12A, KLDR			
F8	Control bus fuse for a 2 kVA control transformer		5A, KLDR			
	Control bus fuse for a 5 kVA control transformer		30A, FRN			
	Control bus fuse for a 10 kVA control transformer		70A, FRN			
F11 - 13	Phase-loss fuses		1A, KLDR			
F14 - 16	Line RC suppressor fuses		25A, KTKR			
HS1 - 2	Bridge heatsink					
MTR1	Bridge fan		1200 CFM			
MTR1-C	Bridge fan capacitor		20 uF capacitor			
MTR2 - 3	Door-mounted fan by choke		6.9", 340 CFM			
MTR4 - 6	Door-mounted fan by CB		6.9", 340 CFM			
PL1	DC-Bus-Energized pilot light		24V AC/VDC, red, 800MR			
PL2	Unit-Not-Faulted pilot light		120V AC, amber, 800MR			
PS1	Air flow sensor power supply		24V DC, 1.1A			
PT1	Control power transformer		A 1 kVA control transformer is standard, 5 kVA and 10 kVA control transformers are available as options. This transformer has multiple taps to accommodate 230, 380, 460, 575V AC primary voltages.			
S1 - 2	Heatsink thermoswitch		220 °F			
S3	Choke thermoswitch					
S5 - 6	Air flow sensor					
SP1 - 3	Line-to-line MOVs		360 J, 275V AC	460 J, 320V AC	460 J, 320V AC	550 J, 385V AC
SP4	Neutral-to-ground MOV		600 J, 550V AC	760 J, 680V AC	760 J, 680V AC	760 J, 680V AC
VM1	DC bus voltmeter		750V DC	750V DC	1000V DC	1000V DC
VM2	Ground fault detector					

Components marked as being options are part of NRU standard options. Not all NRUs will have these components.

Your 3000A DC NRU (Current Code G)

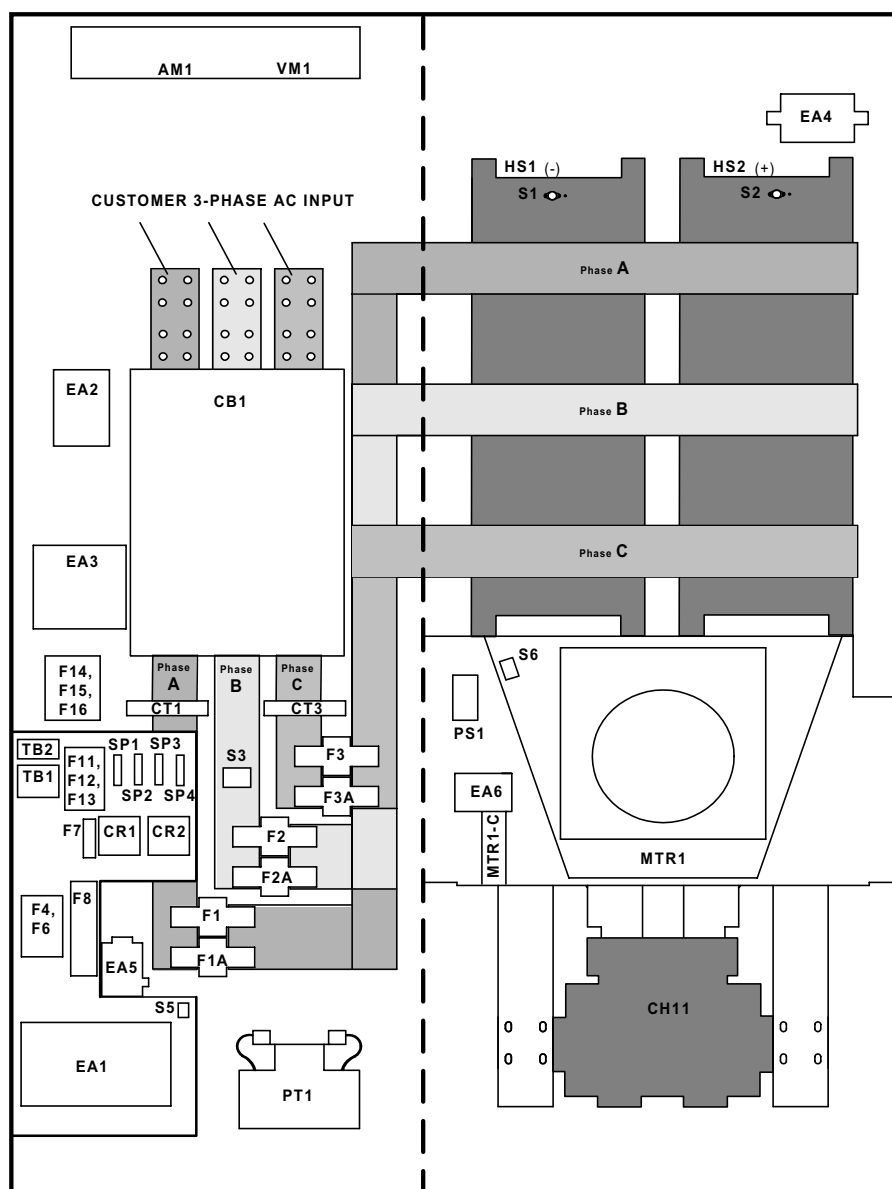
Input Voltage (V AC)	Rated DC Bus kW
230	930
380	1530
460	1860
575	2325

This chapter provides the following information for the 3000A DC NRU:

- a typical cabinet layout diagram (Figure 8.1)
- a typical electrical schematic (Figure 8.2)
- a symbol-to-component reference table for interpreting the electrical schematic (Table 8.A)

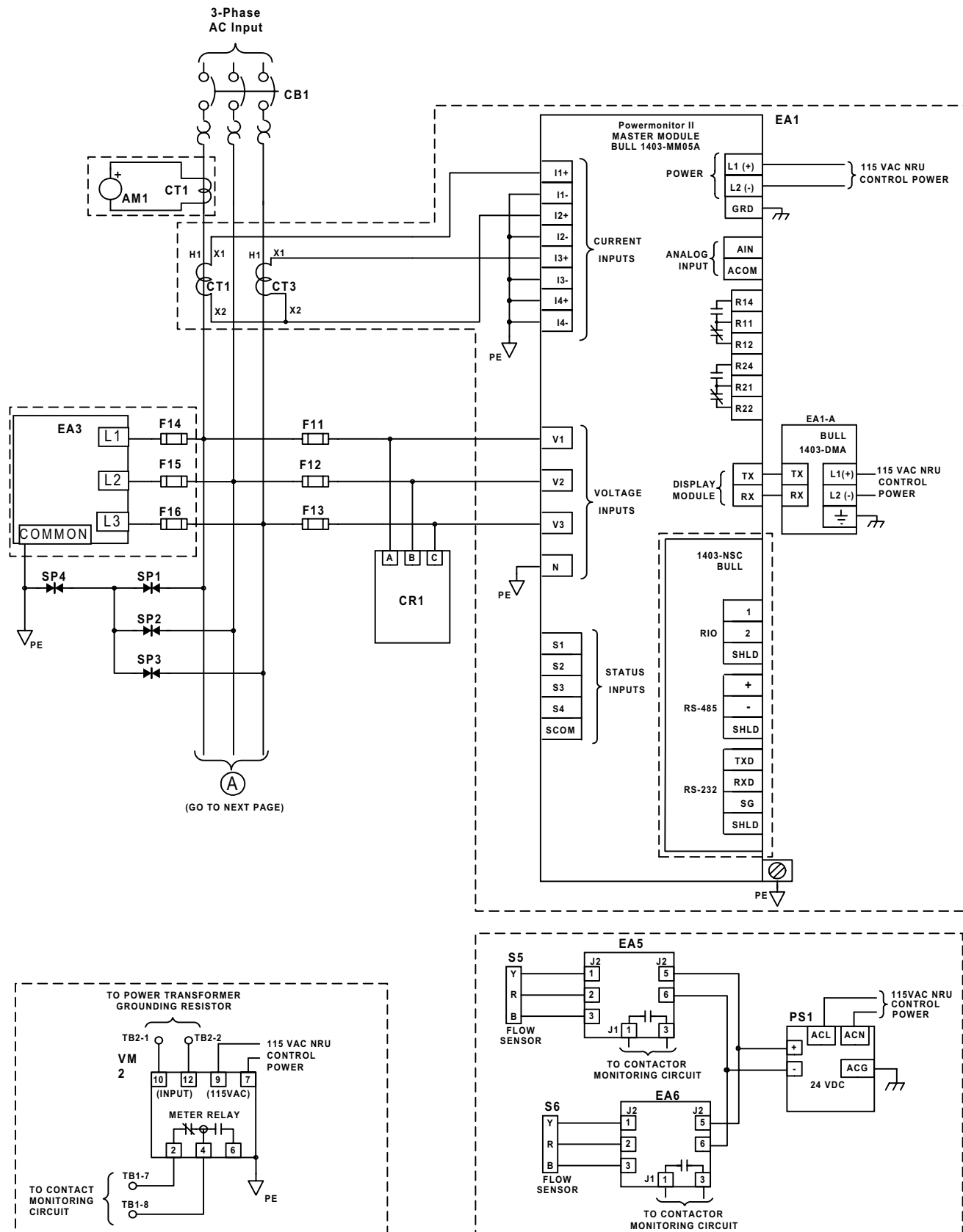
3000A DC System Layout

Figure 8.1
Typical 2000A DC NRU Layout



3000A DC NRU Electrical Schematic

Figure 8.2
Typical 3000A DC NRU Schematic



Important: The Powermonitor II standard configuration works with grounded-wye secondary supplies only. For more information on Powermonitor II configurations for other supply types, consult Powermonitor II documentation and the Power Quality and Automation group located in Milwaukee, WI, USA.

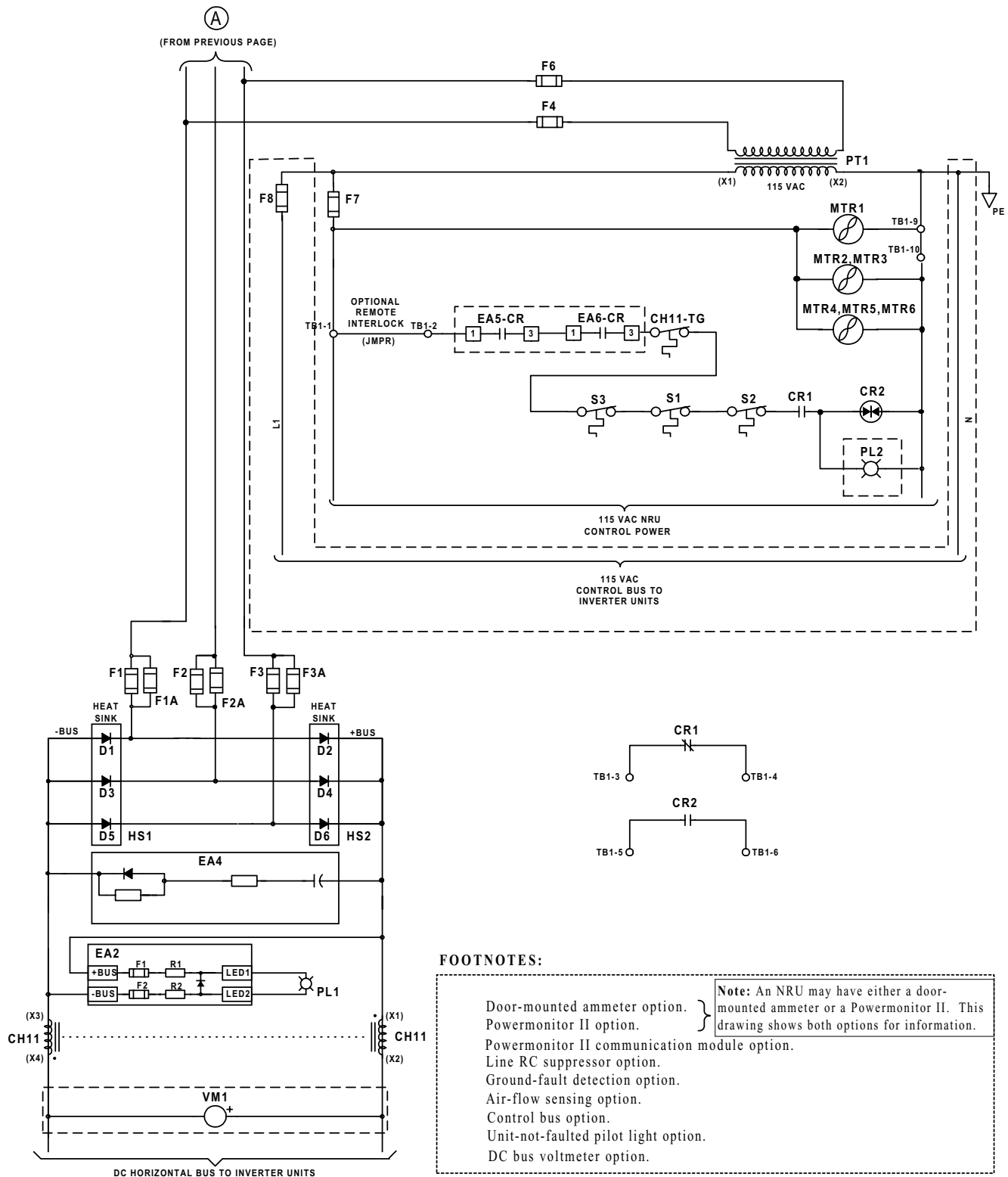


Table 8.A: 3000A DC NRU Symbol-to-Component Cross Reference

Symbol	Description	Option	AC 3-Phase Input Voltage			
			230V AC	380V AC	460V AC	575V AC
AM1	Ammeter monitoring L1		3000A			
CB1	Circuit breaker		3000A R-frame breaker with 3000A plug			
CH11	DC choke		37 uH			
CH11-TG	DC choke thermoswitch					
CR1	Phase-loss relay					
CR2	Fault relay					
CT1, CT3	Current transformer		3000:5			
D1 - 6	Diodes		5000A, 1800V AC			
EA1	Powermonitor II					
EA2	Bus indicator PCB					
EA2F1 - 2	Bus indicator PCB fuses		1A, 1000V, HVR, 1-3/32" diameter, 3" length, 500AIC			
EA3	Line RC suppressor PCB					
EA4	Bridge suppressor PCB					
EA5 - 6	Air flow sensor PCB					
F1 - 3, F1A-3A	Incoming 3-phase, line fuses		1500A, 170M			
F4, F6	Primary fuse for a 2 kVA control transformer		12A, KLDR	8A, KLDR	6.25A, KLDR	5A, KLDR
	Primary fuse for a 5 kVA control transformer		30A, KLDR	17.5A, KLDR	15A, KLDR	12A, KLDR
	Primary fuse for a 10 kVA control transformer		60A, KLDR	35A, FRS	25A, KLDR	20A, KLDR
F7	NRU control power fuse		12A, KLDR			
F8	Control bus fuse for a 2 kVA control transformer		5A, KLDR			
	Control bus fuse for a 5 kVA control transformer		30A, FRN			
	Control bus fuse for a 10 kVA control transformer		70A, FRN			
F11 - 13	Phase-loss fuses		1A, KLDR			
F14 - 16	RC suppressor fuses		25A, KTKR			
HS1 - 2	Bridge heatsink					
MTR1	Bridge fan		1200 CFM			
MTR1-C	Bridge fan capacitor		20 uF capacitor			
MTR2 - 3	Door-mounted fan by choke		6.9", 340 CFM			
MTR4 - 6	Door-mounted fan by CB		6.9", 340 CFM			
PL1	DC-Bus-Energized pilot light		24V AC/VDC, red, 800MR			
PL2	Unit-Not-Faulted pilot light		120V AC, amber, 800MR			
PS1	Air flow sensor power supply		24V DC, 1.1A			
PT1	Control power transformer		A 1 kVA control transformer is standard, 5 kVA and 10 kVA control transformers are available as options. This transformer has multiple taps to accommodate 230, 380, 460, 575V AC primary voltages.			
S1 - 2	Heatsink thermoswitch		220 °F			
S3	Choke thermoswitch					
S5	Air flow sensor					
SP1 - 3	Line-to-line MOVs		360 J, 275V AC	460 J, 320V AC	460 J, 320V AC	550 J, 385V AC
SP4	Neutral-to-ground MOV		600 J, 550V AC	760 J, 680V AC	760 J, 680V AC	760 J, 680V AC
VM1	DC bus voltmeter		750V DC	750V DC	1000V DC	1000V DC
VM2	Ground fault detector					

Components marked as being options are part of NRU standard options. Not all NRUs will have these components.

Installing Your NRU

This chapter provides the following information for the NRU:

- an NRU installation procedure
- NRU checks before power up
- NRU checks after power up

Before You Begin

Before you begin, be sure to have the items in the following list and all items required by referenced procedures.

Documentation

- drive system schematics
- this manual
- Rockwell Automation publication 2300-5.1 (if using a 2300 system) or Rockwell Automation publication S-3062 (if using FD86N cabinets)
- Rockwell Automation publication 2100-5.5

Equipment

- the drive system lineup
- wire or bus (sized per local electrical codes) to connect AC line power to the drive system

Tools

- tools for fastening and removing bolts
- a means to punch holes into sheet metal for the routing of conduit
- a means to connect AC line power to the drive system
- a device for measuring AC voltages (rms)
- a device for measuring DC voltages
- a device for continuity testing

Installation Procedure



ATTENTION: To avoid the hazard of electrical shock, verify that all voltages on the system bus network have been discharged before attempting to service the system.

ATTENTION: Be sure to obey all local electrical codes when installing your drive system. This installation procedure provides guidelines that can be used in the case that codes do not exist.

1.

If your system is in:	Position and connect the NRU to the remainder of drive lineup per drive system installation procedures in:
Bulletin 2300	Publications 2100-5.5 and 2300-5.1.
FD86N enclosures	Publications 2100-5.5 and S-3062.

2. Remove the lifting angle (if present) that is secured to the top of the NRU.
3. Plan where to punch holes for AC input entry. Refer to Appendix C for top plate clearance information prior to punching any holes.
4. Remove the top plate from the MCC.
5. Punch desired holes for AC input entry.
6. Connect top plate to NRU.

If your NRU is rated at:	Connect the NRU input terminals to the AC input power using:
180A DC	One conductor per phase. The input terminals have a range of AWG #4 - 350 kcmil.
350A DC	Two conductors per phase. The input terminals have a range of AWG #3/0 - 250 kcmil.
900A DC	Either a maximum of 4 wires or a bus connector at the four-hole bus tab per phase.
1500A DC or 2000A DC	Either a maximum of 8 wires or a bus connector at both of the four-hole bus tabs per phase.
2500A DC or 3000A DC	Either a maximum of 12 wires or a bus connector at all 3 of the four-hole bus tabs per phase.

Note: Refer to Appendix C for additional wiring information and for bus stab hole pattern details.

7. Set the trip unit of the motor circuit protector/circuit breaker according to manufacturer's instructions or per the recommended settings provided in Appendix C of this manual. Reference the system schematics for the rated current levels.
8. On the phase loss relay, set initial settings on the three knobs as follows: UNDERVOLTAGE and TIME DELAY ON UNDERVOLTAGE to minimum (CCW); IMBALANCE to maximum (CW).

***Note:** Appendix C includes more information about the Phase Loss Relay.*

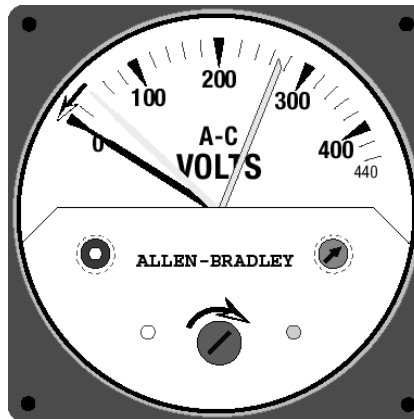
Ground-Fault Detection Option

If the ground-fault detection metering option is supplied on your unit, perform the following procedures.

***Note:** The ground-fault detection relay can be implemented only if the power transformer has a resistive grounded-wye secondary with a resistance of 150 to 300 ohms (1–2A of current during a solid ground fault).*

1. Connect terminals TB2-1 and TB2-2 across the power transformer grounding resistor, in accordance with system schematics and transformer manufacturer specifications.
2. Turn the set screw until the black indicator needle aligns with the 0 (zero) mark as shown in Figure 9.1.

Figure 9.1
Setting the Ground Fault Detection



NRU Checks Before Power Up



ATTENTION: You must perform the checks described in this section before turning power on to the system. Failure to do so may result in personal injury and/or equipment damage.

ATTENTION: You must not turn on the power if the NRU fails any of the checks described in this section. Failure to do so may result in personal injury and/or equipment damage.

ATTENTION: You must correct all problems before proceeding to the next step. Failure to do so may result in personal injury and/or equipment damage.

1. Verify that the NRU does not have any mechanical damage.
2. Verify that the NRU does not have any loose wires or buswork.
3. Using an ohmmeter or other continuity testing device, verify that shorts do not exist between:

Source 1	Source 2	Check below if no short exists
L1	L2	
L1	L3	
L2	L3	
L1	PE	
L2	PE	
L3	PE	
L1	TE	
L2	TE	
L3	TE	
DC+ Bus	DC- Bus	
DC+ Bus	PE	
DC- Bus	PE	
DC+ Bus	TE	
DC- Bus	TE	
PE	TE	

Note: A small short may exist between PE and TE.

NRU Checks After Power Up



ATTENTION: You must not proceed with regular operation if the NRU fails any of the checks described in this section. Failure to do so may result in personal injury and/or equipment damage.

1. Verify that the incoming phase-to-phase line voltage is within the specified tolerances:

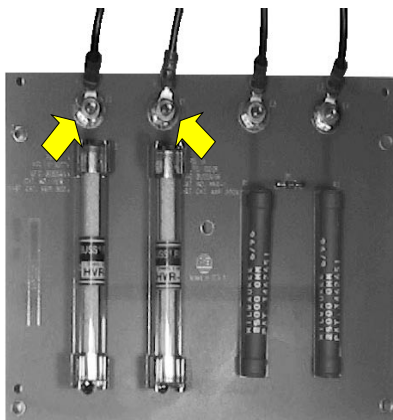
Nominal AC Input Voltage (V AC)	Minimum AC Input Voltage (V AC)	Maximum AC Input Voltage (V AC)
230	207	253
380	342	418
460	414	506
575	518	632

2. The common DC bus voltage will vary based upon the 3-phase AC input voltage. Verify that the common DC bus voltage is within the tolerances:

Nominal DC Bus Voltage (V DC)	Minimum DC Bus Voltage (V DC)	Maximum DC Bus Voltage (V DC)
310	279	341
510	459	561
620	558	682
775	698	852

Note: We suggest that you check the DC bus voltage at the DC bus energized board as shown in Figure 9.2.

Figure 9.2
Where to Check the DC Bus Voltage



3. Verify that the voltage across X1 to X2 (the secondary side) of PT2 (the control power transformer) is within the specified tolerance:

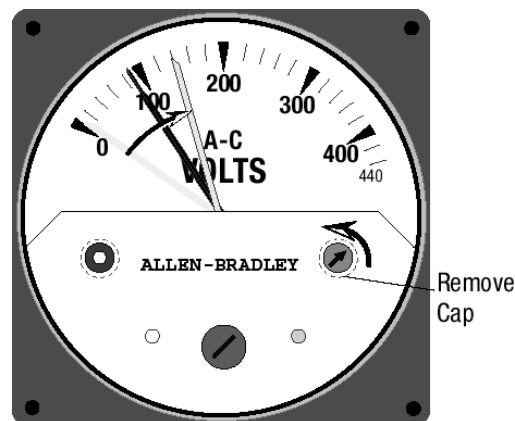
Nominal AC Control Voltage (V AC)	Minimum AC Control Voltage (V AC)	Maximum AC Control Voltage (V AC)
115	104	126

4. Verify that the diode bridge fan is running and blowing air over the bridge.
5. Verify that the "DC Bus Energized" pilot light (PL1) is illuminated.
6. Verify that the "Not Faulted" pilot light (PL2), if supplied, is illuminated. If it is not illuminated, verify that:
 - a. The phase-loss relay (CR1) is energized.

Note: If the phase-loss relay is not energized, disconnect the power and interchange any two input wires and try again.

- b. The other contacts of the circuit are closed.
7. Perform the set up of the Powermonitor II, if supplied, per the manufacturer's instructions.
8. If the ground fault detection meter is supplied, set the red warning indicator needle 50V higher than the maximum value measured by the black needle (up to 200V, maximum).

Figure 9.3
Setting The Warning Trip Voltage



Important: The black needle of the ground-fault detection meter should typically read a low value (between 80 and 100V) when the inverters on the DC bus are modulating. This voltage is produced by capacitively-coupled currents to ground in the motor's cables and windings.

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Troubleshooting

This chapter provides a checklist to use when troubleshooting your NRU.

Before You Begin

Before you begin, be sure to have the items in the following list:

Documentation

- drive system schematics
- this manual

Tools

- a means to connect AC line power to the drive system
- a device for measuring AC voltages (rms)
- a device for measuring DC voltages
- a device for measuring AC currents
- a device for measuring DC currents
- a device for continuity testing

Safety Precautions



ATTENTION: To avoid the hazard of electrical shock, verify that all voltages on the system bus network have been discharged before attempting to service the system.

ATTENTION: The NRU contains stored energy devices. To avoid the hazard of electrical shock, verify that all voltage on capacitors has been discharged before attempting to service, repair, or remove an NRU or its components.

Checklist for Troubleshooting Your NRU

The following table provides a checklist to help you identify the cause of your NRU problem.

Figure 10.1
Troubleshooting Chart

Loss of DC Bus Power & Control Power	Type of Problem		Fault Indication	Did you check the:
	Loss of DC Bus Power Only	Loss of Control Power Only		
				3-Phase AC Incoming Power
				Circuit Breaker or MCP Operation
				3-Phase Fusing
				Diode Bridge
				DC Choke
				Control Transformer Fusing
				Control Transformer Secondary Voltage and/or Secondary Fusing
				Bridge Fan
				Over-Temperature Switch
				Phase Loss
				Phase Imbalance
				External Customer Interlocks (if present)

Important: Refer to the system schematics, Appendix A of this manual, and the chapter of this manual that corresponds to your NRU for ratings.

Specifications

This appendix provides Bulletin 2364E NRU physical, electrical, environmental, and functional specifications.

Physical Specifications

Table A: NRU Physical Dimensions

Output Current (A DC)	Current Code	Height	Overall Width	Overall Depth	Number of MCC Sections
180	A	90" (2286 mm)	25" (635 mm)	20" (508 mm)	1
350	B	90" (2286 mm)	25" (635 mm)	20" (508 mm)	1
900	C	90" (2286 mm)	30" (762 mm)	20" (508 mm)	1
1500	D	91.5" (2324 mm)	55" (1270 mm)	20" (508 mm)	2
2000	E	91.5" (2324 mm)	55" (1270 mm)	20" (508 mm)	2
2500	F	91.5" (2324 mm)	65" (1651 mm)	20" (508 mm)	2
3000	G	91.5" (2324 mm)	65" (1651 mm)	20" (508 mm)	2

The height of 1500 A DC through 3000A DC units includes the 1.5"-high, required base channel. You may choose a base channel for 180A DC, 350A DC, and 900 A DC units; add 1.5 inches to the height if you choose the base channel option.

Approximate Shipping Weights

Table B: Approximate Shipping Weights

Output Current (A DC)	Current Code	Unit Width and Depth	Complete Unit Weight
180, 350	A, B	25"W x 20"D	675 lb (306kg)
900	C	30"W x 20"D	1000 lb (454 kg)
1500, 2000	D, E	55"W x 20"D	1950 lb (885 kg)
2500, 3000	F, G	65"W x 20"D	3000 lb (1361 kg)

Electrical Specifications**Table C: NRU Electrical Specifications**

Nominal Input Voltage (V AC)	Continuous Input Current (A AC)	Nominal DC Bus Voltage (V DC)	Maximum Continuous DC Bus Current (A DC)	NRU Current Code	Rated DC Bus kW	Control Transformer kVA Ratings		
						Basic Capacity	Optional Standard Capacity for Control Bus	Optional Extra Capacity for Control Bus
230	151	310	180	A	56	1.0	2.0	5.0
230	290	310	350	B	109	1.0	2.0	5.0
230	739	310	900	C	279	1.0	2.0	5.0
230	1229	310	1500	D	465	1.0	5.0	10.0
230	1637	310	2000	E	620	1.0	5.0	10.0
230	2050	310	2500	F	775	2.0	5.0	10.0
230	2458	310	3000	G	930	2.0	5.0	10.0
380	150	510	180	A	92	1.0	2.0	5.0
380	288	510	350	B	179	1.0	2.0	5.0
380	737	510	900	C	459	1.0	2.0	5.0
380	1227	510	1500	D	765	1.0	5.0	10.0
380	1636	510	2000	E	1020	1.0	5.0	10.0
380	2047	510	2500	F	1275	2.0	5.0	10.0
380	2455	510	3000	G	1530	2.0	5.0	10.0
460	149	620	180	A	112	1.0	2.0	5.0
460	288	620	350	B	217	1.0	2.0	5.0
460	737	620	900	C	558	1.0	2.0	5.0
460	1227	620	1500	D	930	1.0	5.0	10.0
460	1635	620	2000	E	1240	1.0	5.0	10.0
460	2046	620	2500	F	1550	2.0	5.0	10.0
460	2454	620	3000	G	1860	2.0	5.0	10.0
575	149	775	180	A	140	1.0	2.0	5.0
575	288	775	350	B	271	1.0	2.0	5.0
575	737	775	900	C	698	1.0	2.0	5.0
575	1226	775	1500	D	1163	1.0	5.0	10.0
575	1635	775	2000	E	1550	1.0	5.0	10.0
575	2045	775	2500	F	1938	2.0	5.0	10.0
575	2453	775	3000	G	2325	2.0	5.0	10.0

Refer to Table D for AC input specifications.

AC line current shown is for NRU with basic capacity control transformer. Refer to Table E for AC input current if you have selected a control power source upgrade option.

Refer to Table D for NRU overload capability.

Rated DC bus kW is the power available on the DC thru bus. This value is independent of control transformer selection. To calculate the input kVA, use this formula:

$$\text{input kVA} = \frac{V \cdot A(1.73)}{1000}$$

V = Input Voltage, line to line (V AC, i.e. from column 1)
A = Input Current (A AC, i.e. from column 2)

Functional Specifications

Table D: NRU Functional Specifications

AC Input Frequency Tolerance	45 to 65 Hz
AC Input Voltage Tolerance	$\pm 10\%$
Overload Capability	150% maximum DC bus current for 60 seconds, 200% for 10 seconds following continuous operation
Overload Duty Cycle	1 minute out of 20 minutes at rated load and temperature
Minimum Continuous Load Requirement	33% of rated DC bus continuous current

If the total continuous DC input current of the load is less than 33% of the rate NRU DC bus continuous current, the bus current may become discontinuous.

Input Currents of NRU with Control Source Upgrade Options

Table E: Input Currents of NRUs with a Control Power Upgrade Option

Nominal Input Voltage (V AC)	NRU Current Code	Continuous Input Current of NRU with Standard Capacity Control Source Upgrade Option 6P (A AC)	Continuous Input Current of NRU with Extra Capacity Control Source Upgrade Option 6PX (A AC)
230	A	156	169
230	B	294	308
230	C	744	757
230	D	1246	1268
230	E	1655	1676
230	F	2063	2086
230	G	2471	2493
380	A	152	160
380	B	291	299
380	C	740	748
380	D	1238	1251
380	E	1646	1659
380	F	2054	2068
380	G	2463	2476
460	A	151	158
460	B	290	297
460	C	739	746
460	D	1236	1246
460	E	1644	1655
460	F	2052	2063
460	G	2460	2471
575	A	150	156
575	B	289	294
575	C	738	744
575	D	1233	1242
575	E	1642	1650
575	F	2050	2059
575	G	2458	2467

Thru Bus Ratings per Unit

Table F: Current Ratings of DC Thru Bus

Unit DC Bus Current (A DC)	Thru Bus Rating (A DC)
180	800
350	800
900	1600
1500	1600
2000	3000
2500	3000
3000	3000

Environmental Specifications

Operating Conditions

Table G: NRU Operating Conditions

Altitude	1000 meters (3,300 ft)
Ambient Temperature	0° to 40° C (32° to 104° F) ,
Relative Humidity	5% to 95%, non-condensing

For altitudes higher than 1000 meters, derate using Figure 1.

For temperatures greater than 40° C, derate using Figure 2.

Figure 1
Altitude Derate Curve

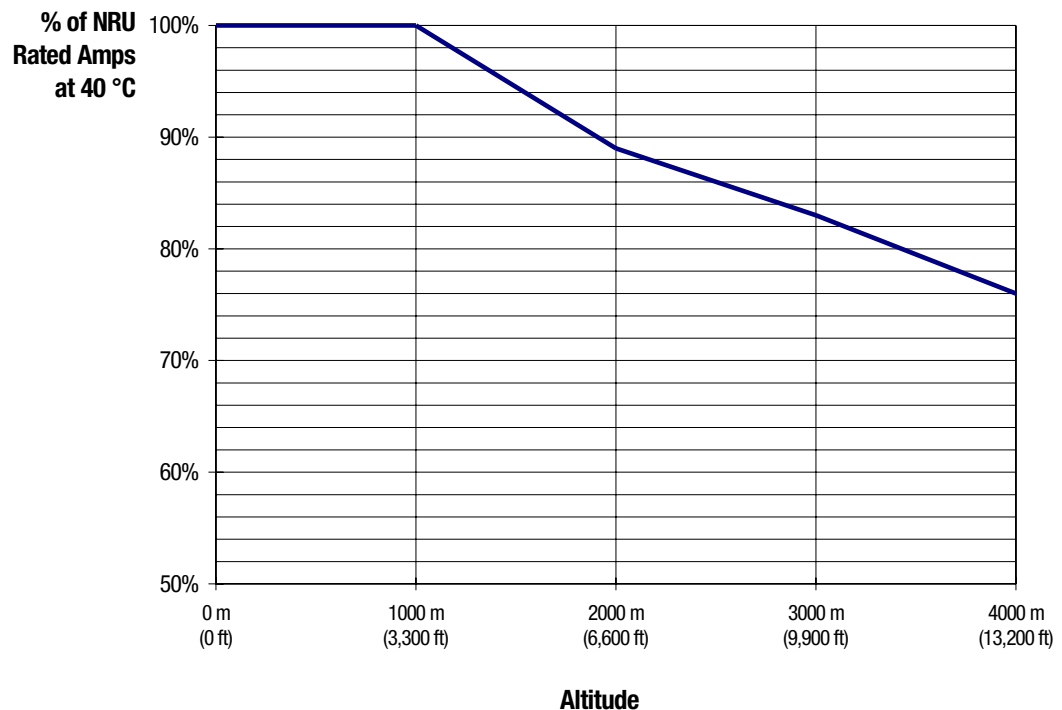


Figure 2
Temperature Derate Curve

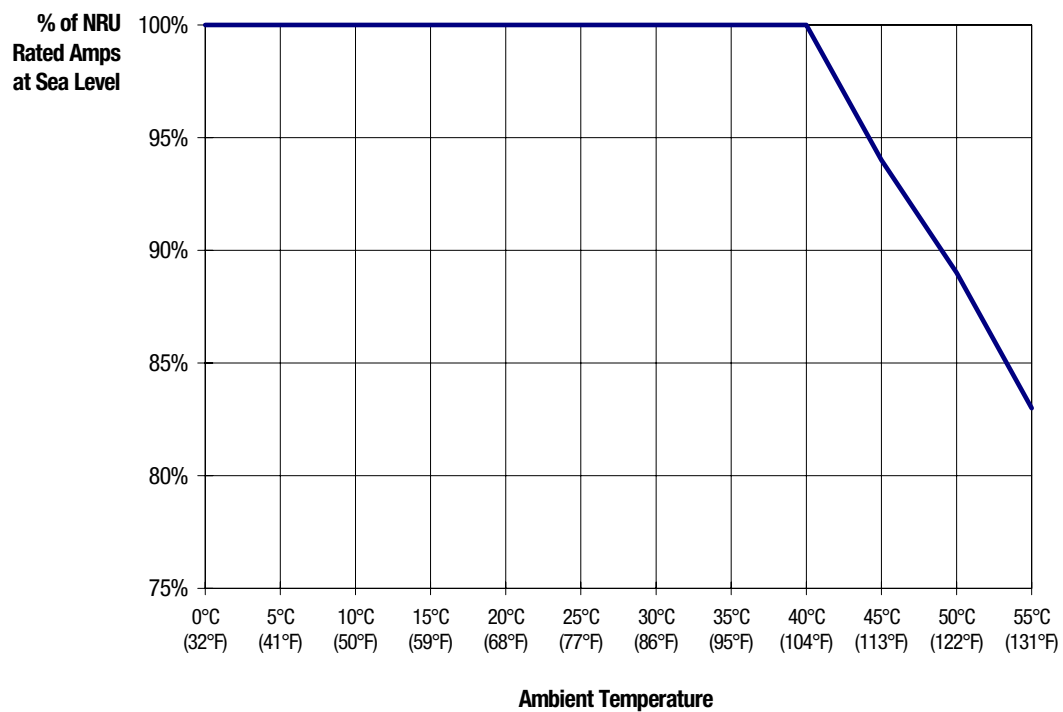


Table H: Operating Sound Level

DC Bus Current (A DC)	Current Code	Average Operating Sound Level (dB)
180, 350	A, B	78
900	C	77
1500, 2000	D, E	73
2500, 3000	F, G	76

Sound level determined using "A"-type weighting.

Figure 3
180A and 350A DC NRU Watts Dissipation versus % Load

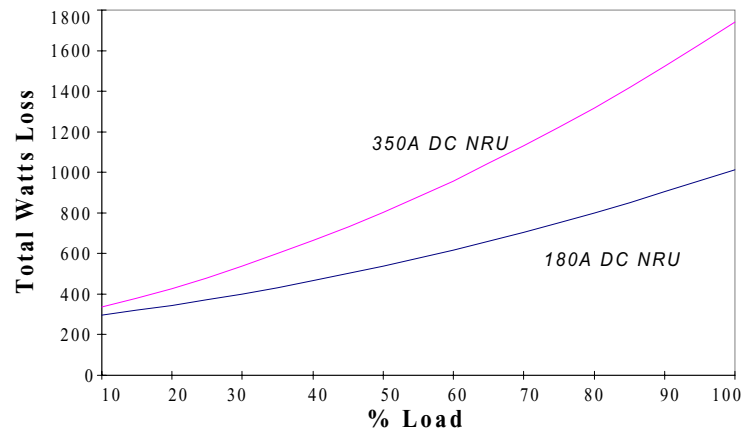


Figure 4
900A DC NRU Watts Dissipation versus % Load

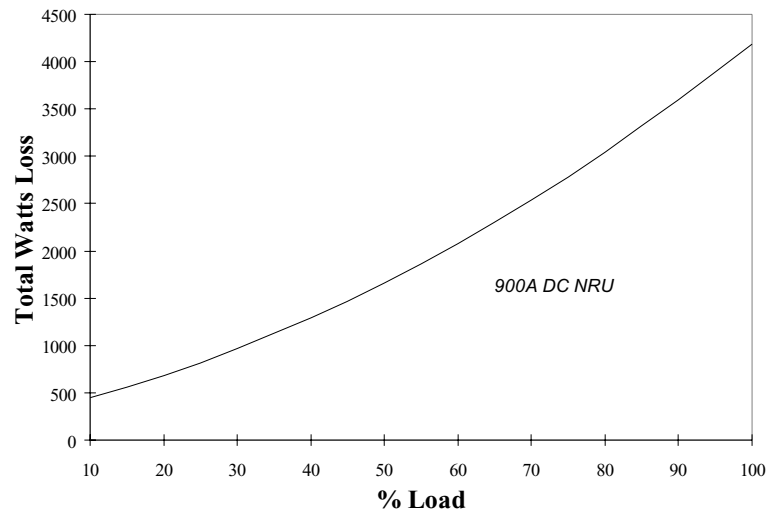


Figure 5
1500A and 2000A DC NRU Watts Dissipation versus % Load

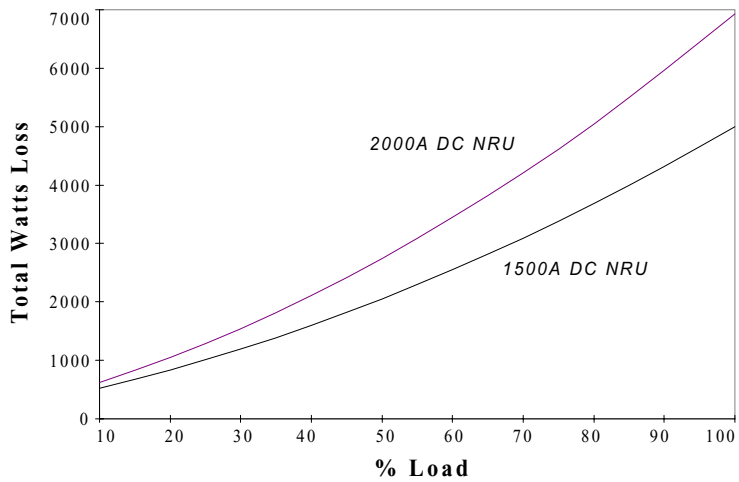
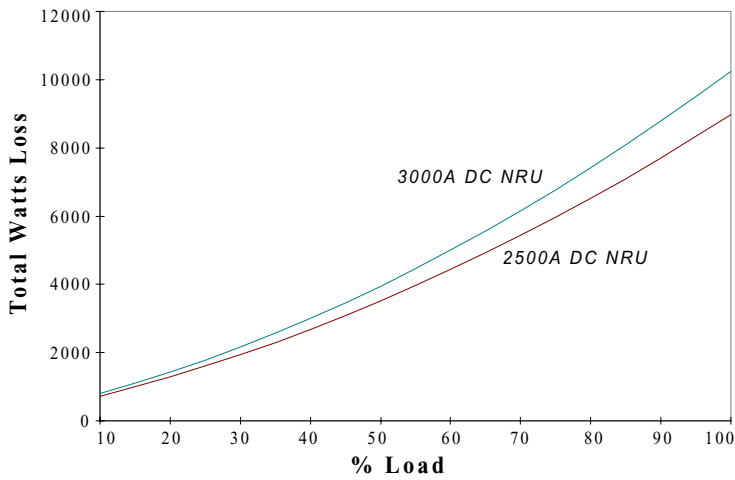


Figure 6
2500A and 3000A DC NRU Watts Dissipation versus % Load



Storage Conditions

Table I: NRU Storage Conditions

Ambient Temperature	-40° to 70° C (-40° to 158° F)
Relative Humidity	5% to 95%, non-condensing

NRU Catalog Numbers and Spare Parts Kits

This appendix provides a description of NRU catalog numbers and lists available spare parts kits.

Understanding Catalog Numbers

Catalog numbers consist of various components that make up a 2364 unit. Each character of the catalog number helps identify a specific NRU. The first four numbers represent the family of products (for example, 2364). The remaining characters define a specific version or option.

Determining Catalog Numbers

To help you to understand, we will provide an example of how to determine a catalog number for a 2364 NRU unit.

The beginning portion of the catalog number for all 2364 NRU units is 2364E (E is for the non-regenerative, DC bus supply unit). The remaining portion of the catalog number will represent the options for which you need to make a selection.

The options must appear in this order:

2364	F	<i>Wiring type</i>	-	<i>Current rating</i>	<i>Enclosure</i>	<i>AC input line voltage</i>	-	XX	<i>Trip device type</i>	-	<i>Options</i>
-------------	----------	--------------------	---	-----------------------	------------------	------------------------------	---	-----------	-------------------------	---	----------------

For example, if you were to use the table on the following page to select an NRU that:

- supplies 1500A DC output
- inputs 460V AC
- has a NEMA Type 1 enclosure without gaskets
- provides circuit breaker input protection
- includes the option:
 - Analog DC Bus Voltmeter

The catalog number would be:

2364EA-DAB-XXCM-715P

NRU Catalog Numbers

Bulletin Number	Unit Type	Wiring Type	Current Rating	Enclosure	AC Input Line Voltage	HP	Trip Device	Options
2364	E	A	—			XX		—
<div>E = NRU</div> <div>A = "A" type</div> <div> A = 180A DC output B = 350A DC output C = 900A DC output D = 1500A DC output E = 2000A DC output F = 2500A DC output G = 3000A DC output </div> <div> A = NEMA Type 1 without gaskets and door fan filters J = NEMA Type 1 with gaskets and door fan filters </div> <div> A = 230V AC N = 380V AC B = 460V AC C = 575V AC </div> <div>XX = Code not applicable</div> <div> CA = High AIC instantaneous trip motor circuit protector (180 to 350A DC) CM = High AIC instantaneous trip circuit breaker with thermal magnetic plug / trip function (900 to 3000A DC) </div>								
<div> <u>Control Power Source</u> 6P = Standard capacity control transformer for control bus 6PX = Extra capacity control transformer for control bus </div> <div> <u>Door-Mounted Pilot Lights</u> 4EA = Unit-Not-Faulted / Control Bus Power On Pilot Light </div> <div> <u>Metering</u> 710P = Analog AC input ammeter (L1 Phase only) 715P = Analog DC bus voltage meter 86MBY = Bulletin 1403 Powermonitor II for NRUs powered by a wye-secondary supply 86NSC = Communication module 1403-NSC for Powermonitor II </div> <div> <u>Protection</u> 88GF = Ground-fault detection 14AFL = Cooling fan air-flow-loss switch 14LSP = Line RC suppressor module </div> <div> <u>Unit Door Nameplates</u> M3EW = White background with black lettering; phenolic label N3EB = Black background with white lettering; phenolic label N3ER = Red background with white lettering; phenolic label </div> <div> <u>Miscellaneous</u> 14WLBL = Brady Datab [™] wire labels J12 = 115V DC, 15A duplex receptacle J11 = Audio phone jack </div>								

Footnotes

System utilization voltages.

Multiple option numbers must be separated by a dash and added to the base catalog number in ascending order.

Each NRU includes a basic capacity control transformer that supplies the NRU with control power. Control power source options allow you to select a higher capacity control transformer for control bus applications. Control power source options include a control bus fuse and control bus. (Refer to the Electrical Specifications section in Appendix A for capacity values.)

Each NRU may have either one AC input ammeter or one Powermonitor II. The Powermonitor II options consists of a 1403-MM05A master module, a 1403-DMA display module, and a master-to-display cable. This standard configuration works with grounded-wye secondary supplies. For information on Powermonitor II configurations for other supply types, consult Powermonitor II documentation and the Power Quality and Automation group located in Milwaukee.

The 1403-NSC option offers communication links to RIO, RS-485, and RS-232. This option may only be selected if 86MBY is selected.

Power transformer must have a resistive, grounded-wye secondary where the resistance is 150-300 ohms.

Units come standard with cloth wire labels. Datab labels offer the added protection of a clear plastic cover on top of the labels.

Customer supplies 115V AC control power and wiring to the duplex receptacle.

The line RC suppressor is recommended for installations where the primary of the distribution transformer is 2300V AC or greater.

Bulletin 2364E NRU Spare Parts Kits

These spare parts kits are designed to provide you with the necessary parts to repair and maintain your NRU.

What Does a Spare Parts Kit Include?

An NRU spare parts kit includes the items in the quantities described in Tables A, B, C, and D. In addition, each spare parts kit contains installation instructions.

Which Table Do I Use?

For an NRU with an input voltage of:	Refer to:
230V AC	Table A
380V AC	Table B
460V AC	Table C
575V AC	Table D

Significance of Level Numbers

Level numbers are used to recommend stocking locations for the various NRU spare parts kits. Level descriptions are as follows:

Level Number	Level Description	Recommended Stocking Location(s)
1	Major Assemblies	Large users, OEMs, distributors, and GTS
2	Minor Assemblies	Distributors and GTS
3	Discrete Components	GTS

Definition of Terms Used to Describe "Qty in Kit"

The column "Qty in Kit" in Tables F, G, H, and J represents how many components you can expect to find as follow:

Type of Kit	Example "Qty in Kit"	Kit Contains
Kits containing one item	1	The specified quantity of the item described
Kits containing multiple items	1 each	The specified quantity of each item described
	1 PCB / 4 fuses	The specified quantity of each item, as described
	1 set	The quantity of the specified items required by one NRU (per set)

Catalog Number Description

2364	-	SP	A	1	A
<i>Bulletin Number</i>		<i>Spare Part Designator</i>	<i>Spare Part Type</i>	<i>Kit Number</i>	<i>Revision Letter</i>

Table A: Spare Parts Kits for NRUs with 230V AC Inputs

Level	Catalog Number	Description	Qty in Kit
1	2364-SPE13A	Control Fuses: Control Transformer Primary, Phase-Loss, DC Bus Energized PCB, 2364E, 1 kVA XFMR, 230V AC / 310V DC, 180 - 2000A DC	2 sets
1	2364-SPE14A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 2 kVA XFMR, 230V AC / 310V DC, 180 - 350A DC	2 sets
1	2364-SPE15A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 2 kVA XFMR, 230V AC / 310V DC, 900A DC	2 sets
1	2364-SPE16A	Control Fuses: Control Transformer Primary, Phase-Loss, DC Bus Energized PCB, 2364E, 2 kVA XFMR, 230V AC / 310V DC, 2500 - 3000A DC	2 sets
1	2364-SPE18A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 5 kVA XFMR, 230V AC / 310V DC, 180 - 2000A DC	2 sets
1	2364-SPE19A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 5 kVA XFMR, 230V AC / 310V DC, 2500 - 3000A DC	2 sets
1	2364-SPE21A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 10 kVA XFMR, 230V AC / 310V DC, 1500 - 2000A DC	2 sets
1	2364-SPE22A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 10 kVA XFMR, 230V AC / 310V DC, 2500 - 3000A DC	2 sets
2	2364-SPA01A	Bridge: Diode Assembly, 2364E, 180 - 350A DC	1
2	2364-SPG01A	Bridge: Diodes, 2364E, 180 - 350A DC	2
2	2364-SPG02A	Bridge: Diodes, 2364E, 900A DC	2
2	2364-SPG03A	Bridge: Diodes, 2364E, 1500 - 2000A DC	2
2	2364-SPG04A	Bridge: Diodes, 2364E, 2500A DC	2
2	2364-SPG05A	Bridge: Diodes, 2364E, 3000A DC	2
2	2300-SPP01A	Switch: Air Flow Switch PCB and Power Supply, 2364E, 180 - 2000A DC	1 each
2	2300-SPP02A	Switch: Air Flow Switch PCB and Power Supply, 2364E, 2500 - 3000A DC	1 each
2	2364-SPE01A	Power Fuses: AC line & NRU control power, 2364E, 180A DC	2 sets
2	2364-SPE02A	Power Fuses: AC line & NRU control power, 2364E, 350A DC	2 sets
2	2364-SPE03A	Power Fuses: AC line & NRU control power, 2364E, 900A DC	2 sets
2	2364-SPE04A	Power Fuses: AC line & NRU control power, 2364E, 1500A DC	2 sets
2	2364-SPE05A	Power Fuses: AC line & NRU control power, 2364E, 2000A DC	2 sets
2	2364-SPE06A	Power Fuses: AC line & NRU control power, 2364E, 2500A DC	2 sets
2	2364-SPE07A	Power Fuses: AC line & NRU control power, 2364E, 3000A DC	2 sets
2	2364-SPP01A	Pilot: Bus Indicator PCB, 2364E, 180 - 3000A DC	1
2	2364-SPK01A	DC Bus Suppressor: Loose Parts, 2364E, 180 - 350A DC	1 set
2	2364-SPB01A	DC Bus Suppressor: Assembly, 2364E, 900 - 3000A DC	1
2	2300-SPB01A	AC Line RC Suppressor: PCB and Fuses, 2364E, 180 - 3000A DC	1 PCB / 6 fuses
2	2300-SPJ01A	MOV: Line-to-Neutral and Neutral-to-Ground, 2364E, 230V AC / 310V DC, 180 - 3000A DC	1 set
3	2364-SPH01A	Bridge Fan and Capacitor, 2364E, 180 - 350A DC	1 each
3	2364-SPH02A	Bridge Fan and Capacitor, 2364E, 900A DC	1 each
3	2364-SPH03A	Bridge Fan and Capacitor, 1500 - 3000A DC	1 each
3	2300-SPH01A	5" Fan, 2364E, Internal Circulation 1500 - 2000A DC	1
3	2300-SPH02A	7" Fan, 2364E, Door Fan 1500 - 3000A DC	1

Table B: Spare Parts Kits for NRUs with 380V AC Inputs

Level	Catalog Number	Description	Qty in Kit
1	2364-SPE23A	Control Fuses: Control Transformer Primary, Phase-Loss, DC Bus Energized PCB, 2364E, 1 kVA XFMR, 380V AC / 510V DC, 180 - 2000A DC	2 sets
1	2364-SPE24A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 2 kVA XFMR, 380V AC / 510V DC, 180 - 350A DC	2 sets
1	2364-SPE25A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 2 kVA XFMR, 380V AC / 510V DC, 900A DC	2 sets
1	2364-SPE26A	Control Fuses: Control Transformer Primary, Phase-Loss, DC Bus Energized PCB, 2364E, 2 kVA XFMR, 380V AC / 510V DC, 2500 - 3000A DC	2 sets
1	2364-SPE28A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 5 kVA XFMR, 380V AC / 510V DC, 180 - 2000A DC	2 sets
1	2364-SPE29A	Fuses, Control, Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 5 kVA XFMR, 380V AC / 510V DC, 2500 - 3000A DC	2 sets
1	2364-SPE31A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 10 kVA XFMR, 380V AC / 510V DC, 1500 - 2000A DC	2 sets
1	2364-SPE32A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 10 kVA XFMR, 380V AC / 510V DC, 2500 - 3000A DC	2 sets
2	2364-SPA01A	Bridge: Diode Assembly, 2364E, 180 - 350A DC	1
2	2364-SPG01A	Bridge: Diodes, 2364E, 180 - 350A DC	2
2	2364-SPG02A	Bridge: Diodes, 2364E, 900A DC	2
2	2364-SPG03A	Bridge: Diodes, 2364E, 1500 - 2000A DC	2
2	2364-SPG04A	Bridge: Diodes, 2364E, 2500A DC	2
2	2364-SPG05A	Bridge: Diodes, 2364E, 3000A DC	2
2	2300-SPP01A	Switch: Air Flow Switch PCB and Power Supply, 2364E, 180 - 2000A DC	1 each
2	2300-SPP02A	Switch: Air Flow Switch PCB and Power Supply, 2364E, 2500 - 3000A DC	1 each
2	2364-SPE01A	Power Fuses: AC line & NRU control power, 2364E, 180A DC	2 sets
2	2364-SPE02A	Power Fuses: AC line & NRU control power, 2364E, 350A DC	2 sets
2	2364-SPE03A	Power Fuses: AC line & NRU control power, 2364E, 900A DC	2 sets
2	2364-SPE04A	Power Fuses: AC line & NRU control power, 2364E, 1500A DC	2 sets
2	2364-SPE05A	Power Fuses: AC line & NRU control power, 2364E, 2000A DC	2 sets
2	2364-SPE06A	Power Fuses: AC line & NRU control power, 2364E, 2500A DC	2 sets
2	2364-SPE07A	Power Fuses: AC line & NRU control power, 2364E, 3000A DC	2 sets
2	2364-SPP01A	Pilot: Bus Indicator PCB, 2364E, 180 - 3000A DC	1
2	2364-SPK01A	DC Bus Suppressor: Loose Parts, 2364E, 180 - 350A DC	1 set
2	2364-SPB01A	DC Bus Suppressor: Assembly, 2364E, 900 - 3000A DC	1
2	2300-SPB01A	AC Line RC Suppressor: PCB and Fuses, 2364E, 180 - 3000A DC	1 PCB / 6 fuses
2	2300-SPJ02A	MOV: Line-to-Neutral and Neutral-to-Ground, 2364E, 380V AC / 510V DC & 460V AC / 620V DC, 180 - 3000A DC	1 set
3	2364-SPH01A	Bridge Fan and Capacitor, 2364E, 180 - 350A DC	1 each
3	2364-SPH02A	Bridge Fan and Capacitor, 2364E, 900A DC	1 each
3	2364-SPH03A	Bridge Fan and Capacitor, 1500 - 3000A DC	1 each
3	2300-SPH01A	5" Fan, 2364E, Internal Circulation 1500 - 2000A DC	1
3	2300-SPH02A	7" Fan, 2364E, Door Fan 1500 - 3000A DC	1

Table C: Spare Parts Kits for NRUs with 460V AC Inputs

Level	Catalog Number	Description	Qty in Kit
1	2364-SPE33A	Control Fuses: Control Transformer Primary, Phase-Loss, DC Bus Energized PCB, 2364E, 1 kVA XFMR, 460V AC / 620V DC, 180 - 2000A DC	2 sets
1	2364-SPE34A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 2 kVA XFMR, 460V AC / 620V DC, 180 - 350A DC	2 sets
1	2364-SPE35A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 2 kVA XFMR, 460V AC / 620V DC, 900A DC	2 sets
1	2364-SPE36A	Control Fuses: Control Transformer Primary, Phase-Loss, DC Bus Energized PCB, 2364E, 2 kVA XFMR, 460V AC / 620V DC, 2500 - 3000A DC	2 sets
1	2364-SPE38A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 5 kVA XFMR, 460V AC / 620V DC, 180 - 2000A DC	2 sets
1	2364-SPE39A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 5 kVA XFMR, 460V AC / 620V DC, 2500 - 3000A DC	2 sets
1	2364-SPE41A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 10 kVA XFMR, 460V AC / 620V DC, 1500 - 2000A DC	2 sets
1	2364-SPE42A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 10 kVA XFMR, 460V AC / 620V DC, 2500 - 3000A DC	2 sets
2	2364-SPA01A	Bridge: Diode Assembly, 2364E, 180 - 350A DC	1
2	2364-SPG01A	Bridge: Diodes, 2364E, 180 - 350A DC	2
2	2364-SPG02A	Bridge: Diodes, 2364E, 900A DC	2
2	2364-SPG03A	Bridge: Diodes, 2364E, 1500 - 2000A DC	2
2	2364-SPG04A	Bridge: Diodes, 2364E, 2500A DC	2
2	2364-SPG05A	Bridge: Diodes, 2364E, 3000A DC	2
2	2300-SPP01A	Switch: Air Flow Switch PCB and Power Supply, 2364E, 180 - 2000A DC	1 each
2	2300-SPP02A	Switch: Air Flow Switch PCB and Power Supply, 2364E, 2500 - 3000A DC	1 each
2	2364-SPE01A	Power Fuses: AC line & NRU control power, 2364E, 180A DC	2 sets
2	2364-SPE02A	Power Fuses: AC line & NRU control power, 2364E, 350A DC	2 sets
2	2364-SPE03A	Power Fuses: AC line & NRU control power, 2364E, 900A DC	2 sets
2	2364-SPE04A	Power Fuses: AC line & NRU control power, 2364E, 1500A DC	2 sets
2	2364-SPE05A	Power Fuses: AC line & NRU control power, 2364E, 2000A DC	2 sets
2	2364-SPE06A	Power Fuses: AC line & NRU control power, 2364E, 2500A DC	2 sets
2	2364-SPE07A	Power Fuses: AC line & NRU control power, 2364E, 3000A DC	2 sets
2	2364-SPP01A	Pilot: Bus Indicator PCB, 2364E, 180 - 3000A DC	1
2	2364-SPK01A	DC Bus Suppressor: Loose Parts, 2364E, 180 - 350A DC	1 set
2	2364-SPB01A	DC Bus Suppressor: Assembly, 2364E, 900 - 3000A DC	1
2	2300-SPB01A	AC Line RC Suppressor: PCB and Fuses, 2364E, 180 - 3000A DC	1 PCB / 6 fuses
2	2300-SPJ02A	MOV: Line-to-Neutral and Neutral-to-Ground, 2364E, 380V AC / 510V DC & 460V AC / 620V DC, 180 - 3000A DC	1 set
3	2364-SPH01A	Bridge Fan and Capacitor, 2364E, 180 - 350A DC	1 each
3	2364-SPH02A	Bridge Fan and Capacitor, 2364E, 900A DC	1 each
3	2364-SPH03A	Bridge Fan and Capacitor, 1500 - 3000A DC	1 each
3	2300-SPH01A	5" Fan, 2364E, Internal Circulation 1500 - 2000A DC	1
3	2300-SPH02A	7" Fan, 2364E, Door Fan 1500 - 3000A DC	1

Table D: Spare Parts Kits for NRUs with 575V AC Inputs

Level	Catalog Number	Description	Qty in Kit
1	2364-SPE43A	Control Fuses: Control Transformer Primary, Phase-Loss, DC Bus Energized PCB, 2364E, 1 kVA XFMR, 575V AC / 775V DC, 180 - 2000A DC	2 sets
1	2364-SPE44A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 2 kVA XFMR, 575V AC / 775V DC, 180 - 900A DC	2 sets
1	2364-SPE45A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 2 kVA XFMR, 575V AC / 775V DC, 2500 - 3000A DC	2 sets
1	2364-SPE47A	Control Fuses: Control Transformer Primary, Phase-Loss, DC Bus Energized PCB, 2364E, 5 kVA XFMR, 575V AC / 775V DC, 180 - 2000A DC	2 sets
1	2364-SPE48A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 5 kVA XFMR, 575V AC / 775V DC, 2500 - 3000A DC	2 sets
1	2364-SPE50A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 10 kVA XFMR, 575V AC / 775V DC, 1500 - 2000A DC	2 sets
1	2364-SPE51A	Control Fuses: Control Transformer Primary, Control Bus, Phase-Loss, DC Bus Energized PCB, 2364E, 10 kVA XFMR, 575V AC / 775V DC, 2500 - 3000A DC	2 sets
2	2364-SPA01A	Bridge: Diode Assembly, 2364E, 180 - 350A DC	1
2	2364-SPG01A	Bridge: Diodes, 2364E, 180 - 350A DC	2
2	2364-SPG02A	Bridge: Diodes, 2364E, 900A DC	2
2	2364-SPG03A	Bridge: Diodes, 2364E, 1500 - 2000A DC	2
2	2364-SPG04A	Bridge: Diodes, 2364E, 2500A DC	2
2	2364-SPG05A	Bridge: Diodes, 2364E, 3000A DC	2
2	2300-SPP01A	Switch: Air Flow Switch PCB and Power Supply, 2364E, 180 - 2000A DC	1 each
2	2300-SPP02A	Switch: Air Flow Switch PCB and Power Supply, 2364E, 2500 - 3000A DC	1 each
2	2364-SPE01A	Power Fuses: AC line & NRU control power, 2364E, 180A DC	2 sets
2	2364-SPE02A	Power Fuses: AC line & NRU control power, 2364E, 350A DC	2 sets
2	2364-SPE03A	Power Fuses: AC line & NRU control power, 2364E, 900A DC	2 sets
2	2364-SPE04A	Power Fuses: AC line & NRU control power, 2364E, 1500A DC	2 sets
2	2364-SPE05A	Power Fuses: AC line & NRU control power, 2364E, 2000A DC	2 sets
2	2364-SPE06A	Power Fuses: AC line & NRU control power, 2364E, 2500A DC	2 sets
2	2364-SPE07A	Power Fuses: AC line & NRU control power, 2364E, 3000A DC	2 sets
2	2364-SPP01A	Pilot: Bus Indicator PCB, 2364E, 180 - 3000A DC	1
2	2364-SPK01A	DC Bus Suppressor: Loose Parts, 2364E, 180 - 350A DC	1 set
2	2364-SPB01A	DC Bus Suppressor: Assembly, 2364E, 900 - 3000A DC	1
2	2300-SPB01A	AC Line RC Suppressor: PCB and Fuses, 2364E, 180 - 3000A DC	1 PCB / 6 fuses
2	2300-SPJ03A	MOV: Line-to-Neutral and Neutral-to-Ground, 2364E, 575V AC / 775V DC, 180 - 3000A DC	1 set
3	2364-SPH01A	Bridge Fan and Capacitor, 2364E, 180 - 350A DC	1 each
3	2364-SPH02A	Bridge Fan and Capacitor, 2364E, 900A DC	1 each
3	2364-SPH03A	Bridge Fan and Capacitor, 1500 - 3000A DC	1 each
3	2300-SPH01A	5" Fan, 2364E, Internal Circulation 1500 - 2000A DC	1
3	2300-SPH02A	7" Fan, 2364E, Door Fan 1500 - 3000A DC	1

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NRU Details

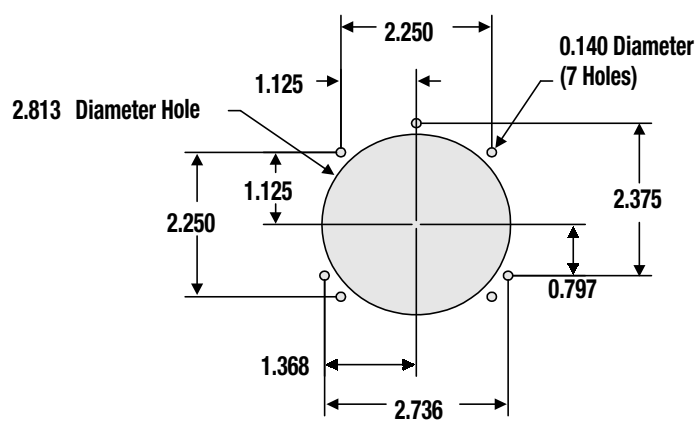
This appendix provides Bulletin 2364E NRU details:

- wireway meter cover details
- AC input connections

Wireway Meter Cover Details

Figure 1 shows the location and sizes of holes that can be made for the mounting of meters in the wireway meter cover.

Figure 1
Details of Meter-Mounting Holes



The quantity of meters that can be mounted on any given meter cover depends upon the meter cover width.

Table A: Meter Wireway Cover Description

DC Bus Current (A DC)	NRU Current Code	For wireway meter cover, see:
180, 350	A, B	Figure 2
900	C	Figure 3
1500, 2000, 2500, 3000	D, E, F, G	Figure 3

Figure 2
25"-Wide Wireway Meter Cover Layout

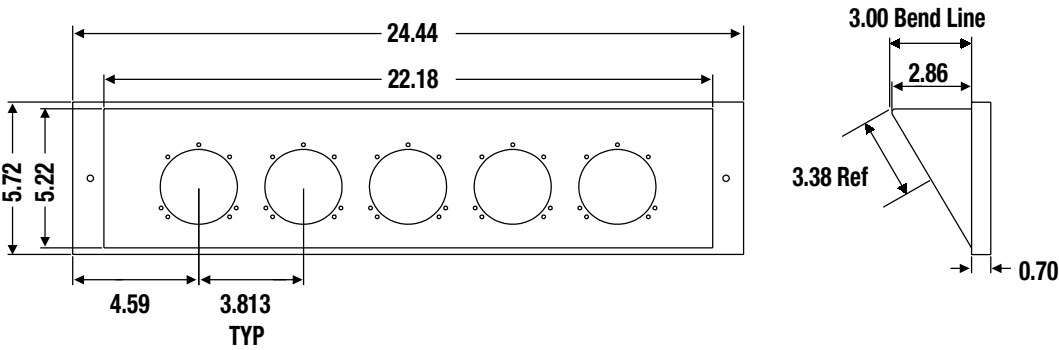
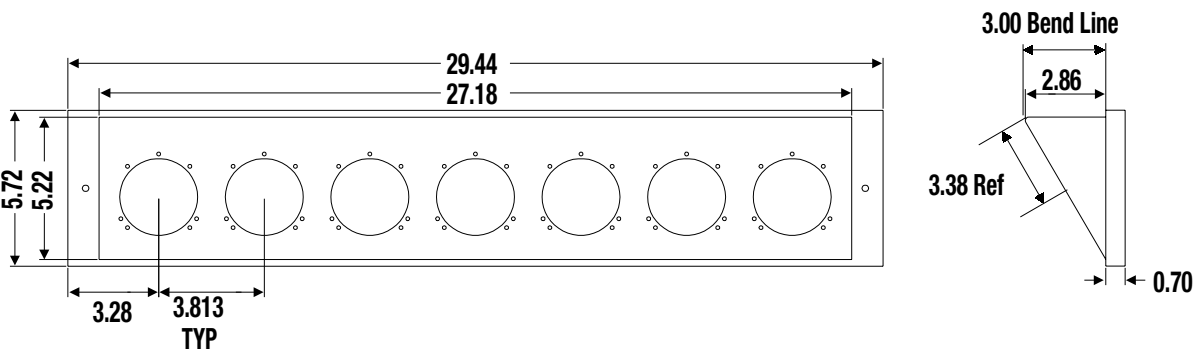


Figure 3
30"-Wide Wireway Meter Cover Layout



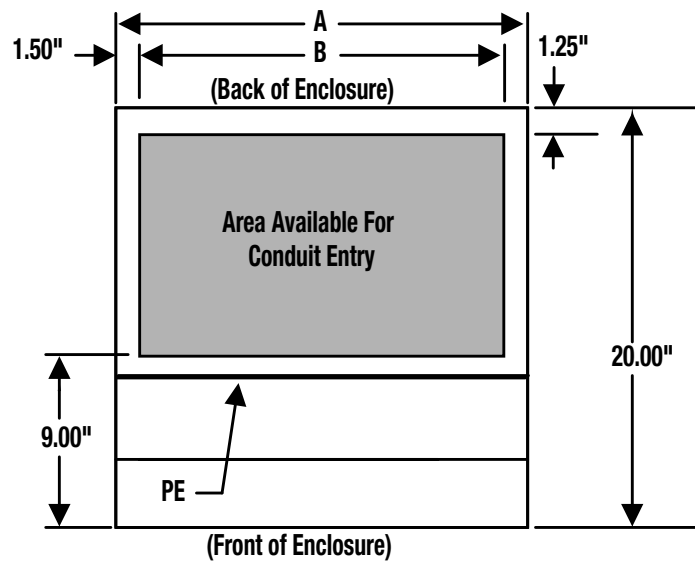
MCC AC Input Entry Area

MCC top plates are removable for the punching of AC input entry holes. Each MCC has a top plate. Please refer to the following illustration for information on available entry area and information given in Chapter 9, or the installation instructions.

Table B: MCC Input Entry Area

DC Bus Current (A DC)	NRU Current Code	Dimension "A" in Figure 4	Dimension "B" in Figure 4
180, 350	A, B	25.00"	22.00"
900	C	30.00"	27.00"
1500, 2000, 2500, 3000	D, E, F, G	30.00"	27.00"

Figure 4
Area Available for Conduit Entry in Circuit Breaker Section



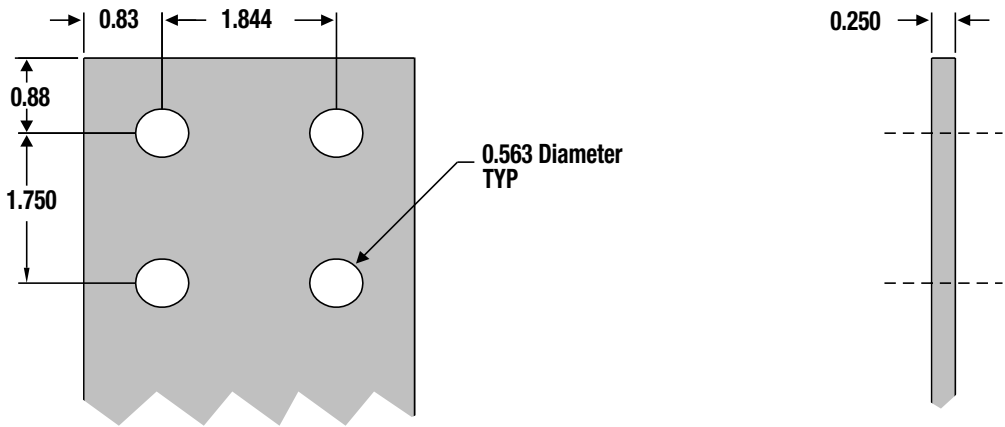
AC Input Customer Connection Details

The type of AC input connection depends upon the NRU current rating.

Table C: AC Input Customer Connection Details

DC Bus Current (A DC)	NRU Current Code	Type of AC Input Connection	Typical AC Input Wire Sizing (per Phase) Based on 125% of Rated Load and 75°C wiring
180	A	Terminals accommodating AWG 4 through 350 kcmil.	One AWG 3/0
350	B	Terminals accommodating AWG 3/0 through 350 kcmil.	· One AWG 500 kcmil <i>or</i> · Two AWG 3/0
900	C	One bus stub per phase. See Figure 5.	· Three AWG 350 kcmil <i>or</i> · Four AWG 4/0
1500	D	Two bus stubs per phase. See Figure 5.	· Five AWG 350 kcmil <i>or</i> · Six AWG 250 kcmil
2000	E	Two bus stubs per phase. See Figure 5.	· Five AWG 350 kcmil, · Six AWG 250 kcmil, <i>or</i> · Seven AWG 250 kcmil
2500	F	Three bus stubs per phase. See Figure 5.	· Seven AWG 500 kcmil <i>or</i> · Eight AWG 400 kcmil
3000	G	Three bus stubs per phase. See Figure 5.	· Eight AWG 500 kcmil

Figure 5
AC Input Customer Connection Bus in 900, 1500, 2000, 2500, and 3000A DC NRUs



Recommended Disconnect Trip Settings

Table D: Recommended Disconnect Trip Settings

DC Bus Current (A DC)	NRU Current Code	Disconnect Description	Recommended Setting(s) shown in:
180	A	Motor Circuit Protector: 250A, J-frame	Figure 6
350	B	Motor Circuit Protector: 400A, K-frame	Figure 6
900	C	Circuit Breaker: 1200A R-frame with 1200A plug	Figure 7
1500	D	Circuit Breaker: 2000A R-frame with 1600A plug	Figure 8
2000	E	Circuit Breaker: 2000A R-frame with 2000A plug	Figure 8
2500	F	Circuit Breaker: 3000A SPB-frame with 2500A plug	Figure 9
3000	G	Circuit Breaker: 3000A SPB-frame with 3000A plug	Figure 9

Figure 6

180 and 350A DC NRU Recommended Motor Circuit Protector Settings

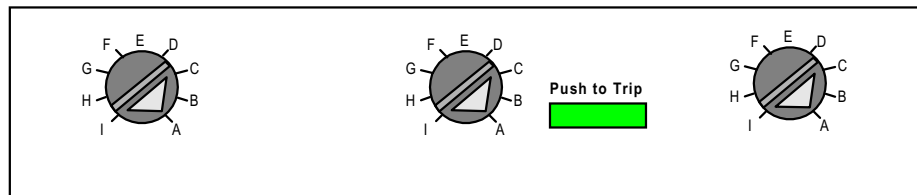


Figure 7

900A DC NRU Recommended Circuit Breaker Settings

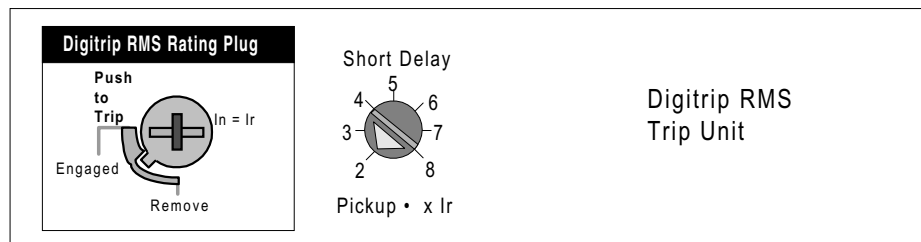


Figure 8
1500 and 2000A DC NRU Recommended Circuit Breaker Settings

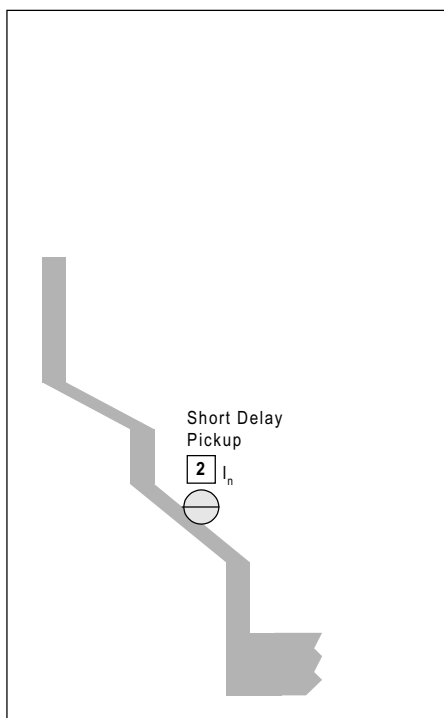
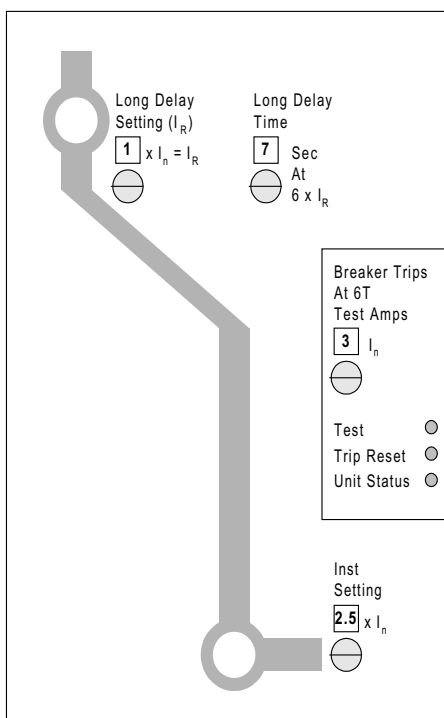


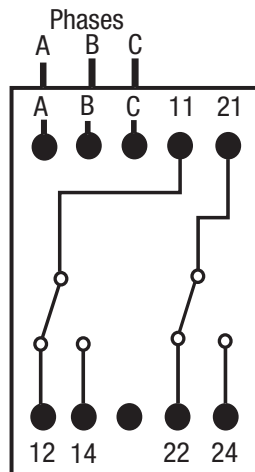
Figure 9
2500 and 3000A DC NRU Recommended Circuit Breaker Settings



Phase-Loss Relay

The phase-loss relay monitors the system for undervoltage, overvoltage, and phase unbalance occurrences. Figure 10 illustrates the phase-loss relay wiring diagram and defines the relay terminals.

Figure 10
Phase-Loss Relay Wiring Diagram



Installation and Setup

1. Set initial settings on the three knobs as follows:
UNDervOLTAGE and TIME DELAY ON UNDervOLTAGE to minimum (CCW); IMBALANCE to maximum (CW).
2. Connect the fused 3-phase line voltage to terminals A, B, and C on the D65 - see Figure 10. A connection to the neutral is not required in Wye systems. DO NOT connect wires to the output terminals until later. (Step 7).
3. Apply Line Voltage. The LED indicator should illuminate and stay steady. If the LED flashes, a fault condition exists and must be corrected. Check to see if all phases are present. REMOVE LINE VOLTAGE, and switch any two of the line voltage connections to insure the phase rotation is correct. Reapply line voltage to check for correct phase rotation.
4. REMOVE LINE VOLTAGE for Steps 4-6. Set the UNDervOLATAGE dial. This setting should be the same as the minimum operating voltage for the equipment to be adequately protected.
5. Set the TIME DELAY ON UNDervOLTAGE dial. This is the maximum time period that an undervoltage condition should exist. Too short a setting will cause nuisance tripping if there are momentary dips in the line voltage. Too long a setting could cause damage to the equipment. Note that the setting should be at least slightly longer than the time a 3-phase motor is drawing its inrush current. This will void a nuisance tripping caused by the starting current.

6. Set the IMBALANCE dial. This setting should be the maximum allowable imbalance in phase voltage that the 3-phase system can tolerate. Too low of a setting can cause nuisance tripping. Too high of a setting may not adequately protect the system.
7. Connect the output terminals as shown in Figure 10.
8. When all connections have been made, apply Line Voltage. The light emitting diode (LED) indicator will illuminate steady, the internal relay will energize, and the 3-phase system will become operational.
9. If the LED flashes during regular operation, one of the four fault conditions has occurred. REMOVE LINE VOLTAGE, and check for presence of all three phases, phase imbalance, and low voltage conditions. Correct if necessary.

Monitor Operation

When the voltage input parameters to the D65 are normal, the red LED will be on. Once the unit has responded to an undesirable circuit condition by releasing the output relay, the LED will blink.

Reset

Upon the correction of the fault condition, the D65 will reset automatically.

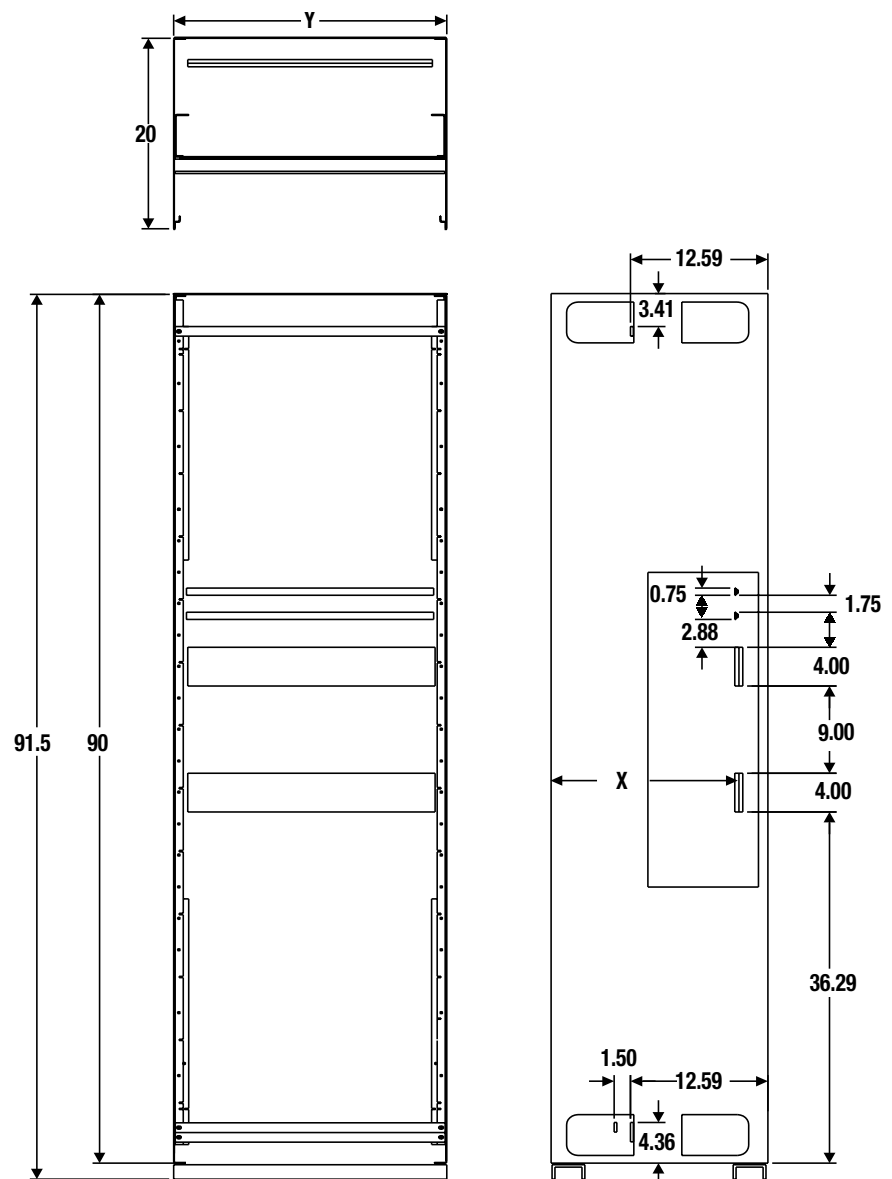
MCC Bus Location Details

Table E provides a list of available DC bus and control bus depths while Figure 11 provides a bus location illustration.

Table E: Available DC Bus and Control Bus Depths

DC Bus Current (A DC)	NRU Current Code	Available Depths for DC Bus and Control Bus (if selected) (See dimension X in Figure 10)	NRU Input Selection Width (See dimension Y in Figure 10)
180, 350	A, B	11.94 inches or 16.94 inches	25 inches
900	C	16.94 inches only	30 inches
1500, 2000, 2500, 3000	D, E, F, G	16.94 inches only	30 inches

**Figure 11
MCC Bus Locations**



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